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Prof. Dr. LÁSZLÓ JAKUCS

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Dr. REZSŐ MÉSZÁROS

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Facultas Scientiarum Naturalium Universitatis Szegediensis

Szerkeszti

Dr. JAKUCS LÁSZLÓ
egyetemi tanár

Technikai szerkesztő

Dr. MÉSZÁROS REZSŐ
egyetemi docens

Kiadja
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THE EFFECT OF ACIDIC ATMOSPHERE POLLUTION UPON STALAGMITES IN KARSTIC CAVE-SYSTEM

L. JAKUCS

Department of Physical Geography
A. József University, Szeged, 6722, Hungary

Preliminaries. Recognition of Occurrence

It was first in Hungary in 1983 that I first reported the occurrence of re-dissolution of some dripstones (mainly on the surface of stalagmites) in karstic cave-systems, a phenomenon which some 5—10 years earlier could not be observed. Unanimously this was to be derived from the corroding effect of karstic waters resulting in the degradation of dripstones. In that phase of researches, relying upon the experimental results of some water samples gathered after realizing this strange occurrence we supposed that all this might have been caused by the softening of dripping water what, in an unknown way, is connected mainly in deep karstic soils with the microbiological and soil chemical equilibrium shifts caused by acidic rains. Namely in the course of my studies I found that the pH of karstic soils covered with natural (mostly arboraceous) vegetation was on an average 1 grade less than the earlier mean pH values.

On the basis of the observed degradation of dripstones and the simultaneous modification of soil processes I had to presuppose a cause and effect interdependence, pointing out that „I am inclined to suppose that acidic (sulphuric, etc.,) precipitation infiltrating the soil does *change not merely the chemical characteristics* of the latter but, as proved by a trend of marked degradation of cave dripping waters, *largely inhibits the earlier level of life conditions for the root-respiration of karstic soils, of microorganisms population, of soil bacterii and soil fungi.*" I suppose that, because of the above mentioned reason, the level of production of biogeneous carbon dioxide becomes restricted what later results in the weakening of hydrocarbonate limestone dissolving effect of the precipitated water oozing through the soil and/or leads to the softening of dripping waters in caves and to the newly observed corroding degradation of dripstones.

It means that the new type of corrosion of cave calcic sediments was regarded already in the early stage of researches as a kind of indication under the surface of the population of the outer atmosphere. Therefore after 1983 I started a wider observation of the occurrence, covering several countries, thus it has become possible to decide whether we have only local or moreover, processes of general validity.

The present paper gives a summary of the result of researches carried out in this field since 1983.

Erosion and corrosion types of degradation of cave dripstones, occurrences and morphological properties of a new type of degradation syndrome

It is very important to make it clear that *not all natural degradation processes of cave dripstones and/or morphological changes of dripstones as a result of the former* are connected with recent changes in the dripstone forming characteristics of karstic waters oozing into caves. Namely we know of lots of dripstone degradations in the most various levels and parts of different karstic caves which were formed postgenetically, that is *after* the development of the dripstone formation itself upon the effect of an actually working natural factor; however, these cannot be regarded as a group of phenomena connected with a most recent degradation syndrome of dripstone formation.

Among the manyfold secondary dripstone varieties produced by different factors we can often find such ones, the appearance of which might be very similar to the morphological characteristics of the recent degradation syndrome, but genetically they have nothing to do with the latter. To separate unequivocally and to define the occurrences it was necessary to examine other types of degradation of dripstones and even the causes of these, since the real proportion and quality of occurrences which I examined as a main profile can be seen in this way.

Below I am going to show my experimental results which have made possible to separate the different variations of dripstone degradations.

1. Erosion types of dripstones degradation

The water entering the active karstic caves wash in through sumps some deposits with more or less solid granules what is washed further on in the caves by underground water flows. Sometimes and somewhere more or less of the deposit is sedimented in the level of caves. Grains of sediment moved by water flows underground do a great deal of mechanical eroding, polishing work, not only on the rock soil or the walls of the caves but on the dripstone formations there, too, if they get into contact with the cave water flow. An especially dynamic degradation of dripstones happens when high waters come (cave flooding), when the amount, the average diameter of grains and even the rate of collision therein of deposits carried by the water are manyfold. This effect leads to a rapid degradation of dripstones, what is called flood degradation. We distinguish here five subtypes:

A.) *Degradation of dripstones by underwashing the bed*

It occurs in stalagmite formations standings by the side of the cave stream when low water, the bottom of which is loose sediment. During high flood the stream may underwash the formations which in times are so enormous that their own weight may cause them to overturn. If the overturned dripstone falls into the stream it will quite soon be worn by the stream deposit erosion. This form of dripstone degrada-

tion is very rapid when the water washes sediments consisting of minerals and pieces of rocks harder than limestone (e.g. quartz sand, pebbles, etc.). Degradation of dripstones by underwashing the bed is a very frequent and general feature in karstic caves with active flow of water and it has characteristics which make it easy to distinguish from other types of degradation.

B.) *Break of dripstones by deposit collision*

In most of the greater active karstic caves there are levels and galleries where time by time the water gets higher. These floods (depending upon the rate of stream) carry floating, salting and rolling deposit. The higher the water the greater is the amount of salting and rolling deposits. In some karstic caves these can be pieces weighing some kiloponds but the occurrence of grains weighing 200—300 g is not rare even in salting deposit (e.g. Baradla, Peace Cave in Aggtelek, Demanova, Punkva in Czechoslovakia, Postoina, Skotzian caves in Yugoslavia.) When, during such events, larger pieces of sediment collide with thin stalagmits got in the flood or pending dripstones, respectively, they easily can break. Dripstone degradations coming from breaks of the above type are well known in each karstic cave with extreme waters, but the identification is the easiest and the most sure in newly discovered parts of caves where there are no antropogenetically degraded dripstones.

C.) *Shelly flood degradation*

Dripstones (stalagmites or rarely even stalactites) which during high flood get into the stream but are strong enough not to break by collision, through erosion take a characteristic shell-shape first of all upon the effect of the erosion by floating deposits. Their surface is as if hollow of spoons were taken. These incurvations touching each other often with sharp edges — but each having smooth surface — can genetically be regarded as stream undulations which correspond to rhythmic thickening and thinning cells of streamlines with different dynamism because of the frictional breaking in every rock surface getting in friction with a stream which does polishing with floating deposit.

In Hungary we can find very fine examples of shelly flood degradation, like e.g. the entrance of "Dripstone Chapel" in Peace Cave.

The effect of erosion by floating deposit streams during high waters can be seen in some dripstone curtains with large surface but of moderate thickness, where we observe the perforation of the formation and the enlargement of the hole with fringed trimming. Such formations are to be observed on dripstone flags in many caves, as a prototype we can mention „Harpoon" near the Rope Ladder Siphon. A sure distinguishing feature of similar formations is that dripstone degradation traces of erosion by deposits can be found on the side of dripstone curtains facing the stream of flow.

At the same time the side of dripstone curtains free of stream show no signs of erosion.

D.) *Degradation caused by lasting high water-level*

In caves where because of different reasons even in periods of low water there are parts where the water level is for a longer time high as compared with the earlier one, we can find an interesting form of dripstone degradation on the surface of dripstones covered by water. This form got the name „emaciation of dripstones". It is mainly characteristic for parts of caves with redamming streamflow, where e.g. the growth of tufa dams across the bed make deeper and deeper the lakes formed from the stream water thus dammed. Damming in caves can of course be caused by other reasons as well, e.g. by landslip or formation of a deposit plug. Practically dripstones got under water this way are not worn by the strong eroding effect of deposits, mostly of the rolling and salting kind, because as a rule deep and wide parts of streambed are formed in the redammed flow where the stream is slow even during the flooding of the underwater stream, thus the effectivity of erosion by water is relatively low as well. Naturally, fine fractions of the floating deposits are present even then and so the dripstones washed for a long time and in the same way by the relatively slow waterflow undergo erosion in a way similar to the effect of rivers on bridge piers. After a time the shape of dripstones becomes sphinx-like, that is, get streamlined as the sphinx rocks in deserts, and mainly the bottom of dripstone columns becomes thin.

The horizontal cut of dripstones degraded in this way by time changes in the manner shown in Fig. 1., viz., because of the more marked erosion of sides parallel to the direction of streaming the dripstone „gets thinner" laterally and the front side changes into a narrow edge (face). We can study this process in Hungary, better to say the results of this process, in some parts of the Radish-Branch of Peace Cave as well as in waterdammed by travertine lower parts of Peace Cave.

E.) *Erosion degradation accompanying recaving*

This is observed in caves or parts of caves which, in a given phase of development, are filled up by a stream, thus not only the cave gets thinner or completely disappears, but the dripstone formations therein are buried as well. If later the material stuffing the cave is evacuated thus the dripstone formations are disintermented we can find very characteristic changes on their surface, partly by soil corrosion and partly by deposit erosion. As a rule side by side or strictly each other we find corrosion substance deficiencies, cavities of irregular shape, sometimes belongimg to particular places, sand and pebble are cemented ti them obviously from the deposit of the stream, furthermore we can see characteristic degradation of dripstone of wave shell or collision with deposit type. The surface of disintermented dripstones usually is very rough, so called screeny, what itself is a proof that the surface of dripstones has got its present form through a series of poligenetic, complex events.

Very fine examples of dripstone degradation formed in the course of repeated vacuation of holes are to be found in Sloupi Cave of the Morava karst, in several parts of Domica in Czechoslovakia first of all in the Dry Corridor and in the Aggtelek part of Baradla; the giant stalagmites at the Black Hall side of the Concert Hall.

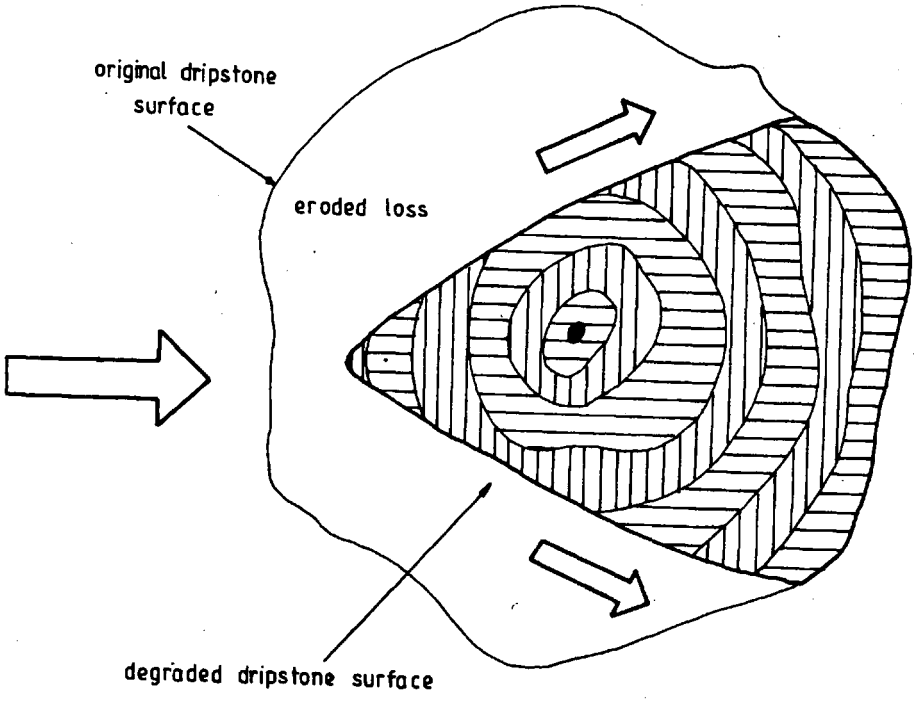


Figure 1. Original and erosion deformed new section of a stone candle attacked by dripstone degradation by lasting high stream water („underdevelopment of dripstone")
Arrows show the direction of floating deposits (original)

2. *Types of recrystallization dripstone degradation*

To this group of phenomena belong dripstone degradations which somehow have casual connection with the swelling of the mass or recrystallization processes taking place in the material of dripstones, in their crystal interspaces or on their surface. Since these postgenetical processes never show signs which could be mistaken for the effect of recent dripstone corrosion syndrome, we only give a rather short description, or only an enumeration.

A.) *Expanding of dripstones*

This can be evoked by different process. I could several times observe dripstones growing like an inflated balloon where the tension of gas inclusions had been working or they were stretched by the extension movement of gas particles first pressed down by oozing karstic water particles and then getting free of this pressure in the cave thus the blisters of the dripstone formed upon the surface of the water drops are enlarged. Very often the high water pressure inside stalactites can play a

role so that the rearrangement of material in the recrystallization of the wall-material of the dripstone helps the crystal to go outwards, rising above the crystal surface.

The radiated-fibrous dripstone globes of „radish-dripstones", very often with a hollow inside, are products of postgenetical crystal formation centres developed from the stalactite material. Very often there are gases or lublinite brushes inside consisting of very fine cottonlike fibres.

Undoubtedly the material of dripstones following the formation of stalactites and stalagmites is working on, and a definite recrystallization process appears especially in the material of pure, not contaminated dripstones. In most of the cases this leads to a marked increase in volume, and we could often observe empty spaces between crystal surfaces of calcite romboeders formed postgenetically which had not been there in the time of dripstone development and in its primary sediment.

B.) *Twisting of dripstones, translation degradation*

A subsequent twisting of the formation is a very frequent phenomenon. This always occurs in the direction of a lasting and undistirbed unilateral diverting force, in part of the cases through slow inner molecular rearrangement following the lasting pressure, or through recrystallizations of crystal translations. We can always observe that the otherwise intact and hard dripstones, breaking very rigidly when hit, become plastic upon the effect of a permanent twisting force.

A very characteristic example of plastic dripstone degradation is the formation of the so-called *dripstone-drum*, what can be regarded very common in some caves (Domica, Postoiana, Peace Cave, etc.). These drums are explained in the literature in various — and quite contradicting — ways.

We think that when a big stalactite does not stick any more on a larger surface to the ceiling, the plane of sticking leaves the ceiling and upon the effect of gravitation it still pends on the edge of hanging and owing to the translation (or hidden) movements of the hanging hinge the whole formation bends downward (see Fig. 2).

C.) *Clay swelling dripstone degradation*

There are stalactites, sometimes even stalagmites in which a considerable amount of clay has been washed in. As a rule the material of terra rossa, covering the surface or of other soils is carried down in the caves and mostly colloidal clay minerals, various silicates and hydrosilicate gels, iron oxides, aluminium, sodium etc. hydroxides and carbonates can build partly in the material of the dripstone, partly between the dripstone layers building upon each other. Dripstone with high clay content can especially frequently be found in carstic caves where the original vegetation coverage had been damaged on the surface and this phenomenon was accompained by the devastation caused by strong soil erosion.

If the disintegration of clays in dripstones and the chemical reactions of different decay derivatives go further on inside the dripstone (what is not a very rare phenomenon) fairly peculair dripstone degradations may occur. Mostly irregular crackings, sometimes whole networks of fractures are formed on the surface of dripstones and through these different substances „boil out" of the inside of the dripstone.

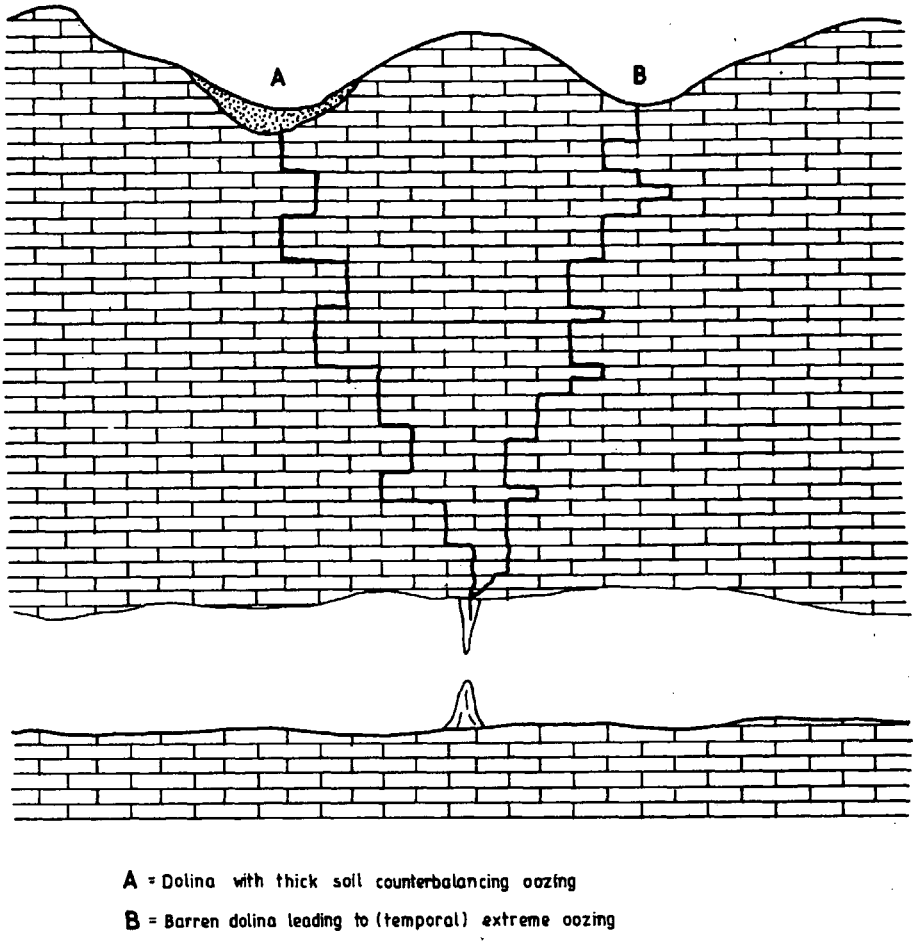


Figure 2. Three phases of the formation of „stalactite drums" (Interpreted by *L. Jakucs*)

Very often white calcite welding ridges bulge alongside the cracks which are lighter than the dominating colour of the dripstone, very often white. Moreover crystal needles or helyctites of different length and obliquity may protrude. These are degradation phenomena being in very close causal connection with the swelling of the mass accompanying the disintegration processes of the collodial clay minerals inside the dripstones.

D.) *Frost-swelling dripstone degradation*

A very characteristic form of dripstone degradation in parts near the entrance of caverns where the air circulation is very strong (and in winter is moving inwards)

as well as of bigger cavern entrances is the crumling of dripstones caused by freezing. In Hungary it is rarely found, I saw traces in the 150 m long part under the Aggtelek main entrance of the Baradla Cave (in „Bone Castle" and in the bed of the Acheron — down to Királykút —, in caves with wide entrance in Istállóskő and Selim Caves, The aggressive ice cracking effect accompanying the freezing of water in the texture of dripstones resulted in a very marked crumbling of dripstones at all the places.

3. „Traditional" types of corrosion dripstone degradation

It is not rare in karstic caverns that we find traces of dripstone degradation processes caused by corrosion i.e. the recrystallization of the material of the dripstone in some way. This may have lots of causes and the system of effect mechanism of reasons and of degradation phenomena are quite well known. There are types of dripstone degradations caused by corrosion, the genetics of which are independent of age, i.e. which can be formed *in all the phases* of development of a cavern; the conditions of their formation were given in the ancient history of the cave (or of some parts of it) as well as in our time. The results of our researches prove the existence of corrosion processes which destroy dripstones in the caves only *recently:* these could not be observed in the cave formations some decades earlier.

The first group, namely corrosion changes independent of age comprise *corrosion of unsaturated cave waters, mixing corrosion*, dripstone corrosion by condensation of vapours, corrosion of the cave soil and clay in karstic waters, guano corrosion and corrosion of dripstones at the cave entrances. All these are *traditional* or *permanent* types of corrosion dripstone degradation, because they were present thousand or even twenty thousand years ago and their effect is to be felt even today. But we have to distinguish a very peculiar group of degradation which *nowhere* appeared *before* but it is characteristic feature of the twentieth century and therefore is called *„recent dripstone degradation syndrome"*.

In this part of my paper first I deal with the permanent sorts of dripstone corrosion then the new type of degradation syndrome will be treated with in the next (II/4) Chapter.

A.) *Dripstone corrosion of unsaturated cave waters*

Under natural conditions smaller and larger amounts of water get into the karstic caves. This water does not yet contain dissolved limestones in a quantity equivalent to its limestone — dissolving capacity. Such unsaturated waters are the temporal *floodwaters*, coming together from the non-karstic drainage basin and entering the caves through ponors and in the case of caves having constant non karstic flow-in streams the source of which is in a non-karstic area. To this can be added in karst plateaus with more or less impermeable clay or other rock cover waters from dolinas and other karst fissures which drain water after heavy rains and snow melting. But especially in areas with cold climate and highland karst plateaus near snow-limit where there is no vegetation or bioactive layer of soil and the

temperature of the rock where the cave is has a very low temperature, near 0°C, even karst waters oozing down very slowly can reach cave level in unsaturated state.

Of course, unsaturated waters can dissolve the material of the dripstones when getting in touch with them. In some cases this process does not leave conspicous traces on the dripstone surface but sometimes its degrading effect easily can be seen. Traces of corrosion by unsaturated cave waters are difficult to detect first of all on dripstones which stand in the cave river-bed or hang in there because these dripstones are destroyed by the erosion of deposits which has a more marked degrading effect than dissolving has. Thus the intensive marks of erosion degradation hide or even demolish the much less visible prints of corrosion degradation. However, traces of corrosion by unsaturated waters can well be seen on dripstones or rock surfaces in the line of the run of water which are not exposed to the effect of flood waters because they lay higher. In these dripstones and parts of rock walls marked dissolved holes, drain canals exactly reflecting the direction of gravitation, so called *cave karrs* are being formed by corrosion.

Naturally, cave karrs are first of all peculiar forms of corrosion of the rock wall of the cave itself, since where unsaturated waters from the surface regularly and repeatedly can penetrate there the conditions of formation of dripstones are usually absent. In spite of this I know of a few cave karrs formed upon dripstones as e.g. in Amateurska-Cave of the Morva karst. But it seems very probable that these occurrences in all cases reflect a process of formation in several phases connected with changes in the climate. For example there is no recent formation of dripstone on the enormous corroded dripstones in Amateurska Cave. Therefore the dripstones themselves which, by the way, at the mentioned place cover with thick layers the rocks in the cave unequivocally were formed in a time (probably during a warm interglacial) when the climatic conditions were much more favourable there for the development of bioactive soil process. But it can also be imagined (the question is to be decided by further topographical investigations) that in out time the surface of related region of inflow has got deserted, its soil eroded and this is the reason why the waters oozing in the karstic area are so markedly unsaturated.

B.) *Mixing corrosion dripstone degradation*

In principle mixing corrosion can produce dripstone degradation which is morphologically equivalent to the effect of recently formed dripstone degradation. Therefore I have paid special attention to this problem.

It is well known that during mixing equilibrium hydrocarbonate solutions (e.g. natural subsoil waters and karstic waters) we get excess carbon dioxide in the solution, that is the solution becomes agressive towards limestone, dissolves it, since excess carbon dioxide depending upon the conditions either evaporates or results in further dissolving $CaCO_3$.

Practically it is not, but theoretically it is possible that in the dripstone caves there are creeks carrying karstic waters of different hardness which meet just at the point of fixation of a stalactite. In this case — from the point of view of the development of the dripstone — we can consider the following variations:

a.) water is carried to the stalactite only by one creek (the *dripstone is growing*);
b.) water is carried simultaneously to the stalactite by both creeks (the *dripstone is degraded because of mixing corrosion)*, and finally
c.) water is carried constantly by one and recurrently by the other creek to the dripstone (then *the latter sometimes grows sometimes is degraded or redissolved.)*

Naturally sometimes both creeks may be inactive but this bears no interest for us. (See Fig. 3).

Further potential places of mixing corrosion dripstone degradation are lineaments which are the line of meeting of adjacent basement of two or more stalagmites each with an own feeding. Namely here karstic waters oozing down the sides of adjacent stalagmites, while they constantly build their own stalagmites, become corroding when they flow together and behave like an agressive solution along the line of flow.

The degradation of mixing corrosion can naturally be felt where the surface of the dripstone (mainly stalagmite) is drizzled by the spray of water falling upon another dripstone. However, as a final result one effect (either the growth or the decay of the dripstone) becomes dominating because the resultant of forces with oppositing characteristic is constant and so the dripstone is further growing or its formation, development is radically inhibited.

Either of the variations of dripstone degradations by mixing corrosion had been examined we had to see that in spite of the similar morphology of degradation this cannot be mistaken for recent degradation syndromes, since these latter appear only on the surface of dripstones recently formed and they are at most a few years old.

C.) *Vapour condensation dripstone degradation*

Near the entrance of larger caverns where the opening is relatively high, summer vapour condensation on the surface of rocks and dripstones is quite typical. The phenomenon is caused in a way that these caverns have marked dynamic air circulation and through high openings, chimneys a strong inward air current develops. The air which is warmer than that inside the cavern gets cooler upon the fact of the cold rock wall of the cave, and in the meantime the relative vapour content becomes so high that on the cooler surfaces the vapour precipitates. Of course this humidity has a corroding effect since it is practically a totally unsaturated solution. Upon the effect of precipitation (happening repeatedly and many times) the surface of the dripstone becomes *blind*, by time it is *encrusted*, touches almost like earth, and naturally in the meantime the glassy, even bright surface disappear. This process can clearly be traced in the Bat-branch of the Baradla Cave. what is more, through this branch vapour condensation sometimes permeates the Black Chamber.

There is a winter variation of vapour condensation in caves. Then, through low openings the cold winter air enters caverns with dynamic air circulation and getting

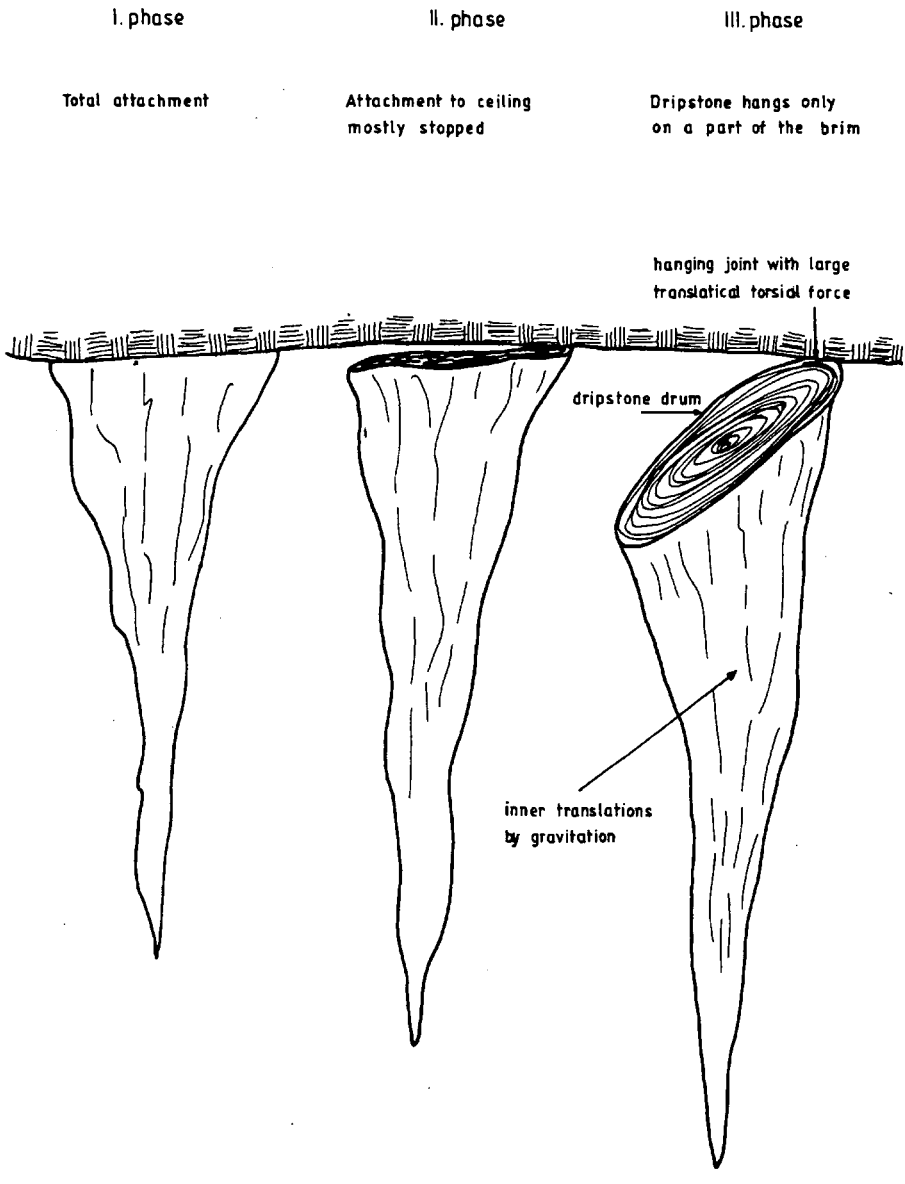


Figure 3. An attempt to interpret temporal mixing corrosion dripstone degradation (original)

warmer there exerts a drying effect. But it is not rare in a region where outside cold air and warmer inner one are mixing, sometimes form layers upon each other, that cave mist is formed, what is a typical form of the appearance of winter vapour condensation in caves. True, this mist is soon absorbed on the surface of dripstones and rocks so it has no corroding effect.

D.) *Corrosion by cave soil and karst water clay*

Deposits carried by waters flowing in caves often cover the dripstones thus these latter often get under the effect of corroding solutions while thus buried. A considerable dripstone corrosion can mainly develop under layers containing organic substances, humus-like earth and debris which can further disintegrate under the conditions of the cave — the intermediate cause of this are mainly solutions which exert acidic effect. But under deposits composed of chemically neutral end products (quartz sand, dolomit sand, quartz pebbles etc.) there is generally no corrosion — these deposits can conserve the buried by them dripstones quite intact for a relatively long period.

A rather peculiar type of dripstone degradation is the so called *quartz water clay corrosion* what is mainly characteristic for cave levels under quartz surfaces which become desolated. According to our investigations dripstones of barren quartz are mostly inactive, their surface is blind and colour is brown, ochre or clayish-grey. Because of the clay- and iron-content eroded on the surface and being step by step washed in the recent developing caves have a lower carbonate content and the newly formed layers are soft, containing a lot of non-carbonate mineral contamination. Of course, these alien „inclusion" materials building inside the dripstone, moreover into the texture of dripstone, further work there, demolish the material of the dripstone.

E.) *Guano — corrosion*

This is a dripstone degradation process characteristic for caves where bats dwell. Especially at places where crowds of the animals stay for longer periods (regions of the winter sleep) on the effect of various acidic compounds in the manure of that the dripstones are demolished, craters are formed and even they can completely dissolve. In consequence of dissolution mineral brushite ($Ca\ HPO_4 . 2H_2O$) can be formed. A classical place of this occurrence is Domica in Czechoslovakia.

F.) *Corrosion of cave entrances*

In regions with a milder climate it is very rare that dripstones are formed near the entrance or even if they are the breaking effect of frosts, the frequent changes in temperature ruin them very soon, therefore not much of the effect of postgenetical dripstone corrosion can be studied near cave entrances. But it is also true that in regions with a climate much more favourable for dripstone formation than ours is (e.g. tropical karst) the extent of dripstones formation is so considerable at the entrances (and even at the outer rock surface of the mountainside) that the special corrosion factors revealing themselves there (as e.g. corrosion by direct rainfall,

biogenic acid corrosion of the roots of plants and direct rock dissolving role of various mosses and ferns living upon dripstones) can be deciding in the morphology of dripstones.

Since these are effects more or less of the same nature, we have to mention here the so called *lamp floracorrosion* of parts of caverns which are brightly lit for the tourists. This is a process which have already been exerting degrading effect on dripstones in several caves in Hungary. On the surface of dripstones brightly lit for longer times with very strong lamps (when warming effect is considerable as well) green plant covers have developed. Under this cover holes, hollows are formed and the moisture coming from the green plant coat paint the limestone back and corrosion occurs as well. To solve the task how to avoid this damage is well known: lamps with cold light must be used and a very close illumination is also to be avoid.

4. The syndrome of recent dripstone degradation

To the symptomes of recent dripstone degradation observed and described by us the first time belong damages of dripstones of only a few years (perhaps decades) of age what almost always appear at the most constant places of dripping of the caves and similar changes can be found in older layers or surface of the same formation. It is fairly easy to check these observations in caves which have been widely known and frequented for ages and as a memory of the time when visitors came with torches (as late as the early twentieth century) the surface of dripstones and rocks at that time were covered by soot. The essence can easily be summarized: *under the cover of soot the degradation syndrome of dripstone redissolution what we are looking for can never be found.* Thus in the process of development of our caves we can clearly distinguish an undisturbed period of development ""prior to sooting" and a very short (lasting at most for only a few decades but we have known of this for a few years) period of active degradation what left a trace of a very effective recorrosion on the surface of many cave dripstones and, in some cases, destroyed the whole dripstone formation.

According to my observations this recent dripstone degradation is mostly characteristic for the young and light (sometimes white) dripstones and results in sharp edged irregular craters, calderas with cracked sides, ditch-beds of oozing with sharper brims, sometimes in the zone of the spraying of drops falling down there is an areal dripstone surface redissolution and not rarely a total dissolution or softening of the greasing substance of the dripstone.

Researches on areas of development on recent degradations syndrome in some karstic countries of middle-east Europe and the Balkan peninsula

Some years ago the phenomenon of recent redissolution of dripstones was observed in the Aggtelek dripstone cave (Baradla Cavern). Soon after the same process was found at several points of Gombaszög Cave in Czechoslovakia. During the 1984-85 research period our studies were carried out in several other European countries, first of all in those having a common border with Hungary.

The investigated karsts and caves, resp., are shown in Fig. 4.

In the caves examined from the point of view of recent dripstone degradation the syndromes were almost everywhere found where dripstones of active development were characteristic. However, this syndrome could not be detected where there are no dripstones or the cave dripstones are inactive, mostly very aged.

The regional peculiarities and magnitude of occurrence are described in the following, relying upon results so far gained.

Austria

In summer 1985 two caverns were examined, Eisriesenwelt in mount Tennen and the Mammuth Cave in the Dachstein mountains. Both caverns have their openings in the highlands, the karstic areas over the caves are barren, practically there is no soil and throughout the year are covered by ice or snow.

Eisriesenwelt is a system with fairly dynamic air current through the entrance of which, in an altitude of 1656 the outer cool air moves inward the cave so a part of the passage is glacified (ice formations cover about 20 000 m^2 of the cave). However, in most of the corridors of the cavern which has been explored in about 42 km length the temperature is over zero, thus water is not glacified. From the point of view of dripstone formation, however, this enormous network of caves is rather poor. We could easily study inside erosion cave-genetics, water deposits coming from the non-karstic drainage basin can easily be seen everywhere and very often well developed cave karrs are upon the rocks as a proof that the limestone-dissolving velocity of waters with a low saturation of carbonic acid, oozing into the cold karst is weak so these solutions can get deeper down being unsaturated. (See: L. Jakucs: Morphogenetics of karsts, 1971, pp. 136—138). No traces of the recent dripstone degradation were found in the cave. We suppose because recent dripstone formation is not characteristic for the cavern either.

The formations and speleoclimatological conditions of *Dachstein-Mammuthöhle*, 20 km of which are disclosed, remind of the conditions of the ice-free parts of Eisriesenwelt. The cave karr-formation and *dynamic corrosion* of oozing waters, respectively, of the cave is more expressed what in several places resulted in considerable crushing of the rock formations, in developing sharp rock edges with steep sides, remaining ridges, at some places real „badland" phenomena. The

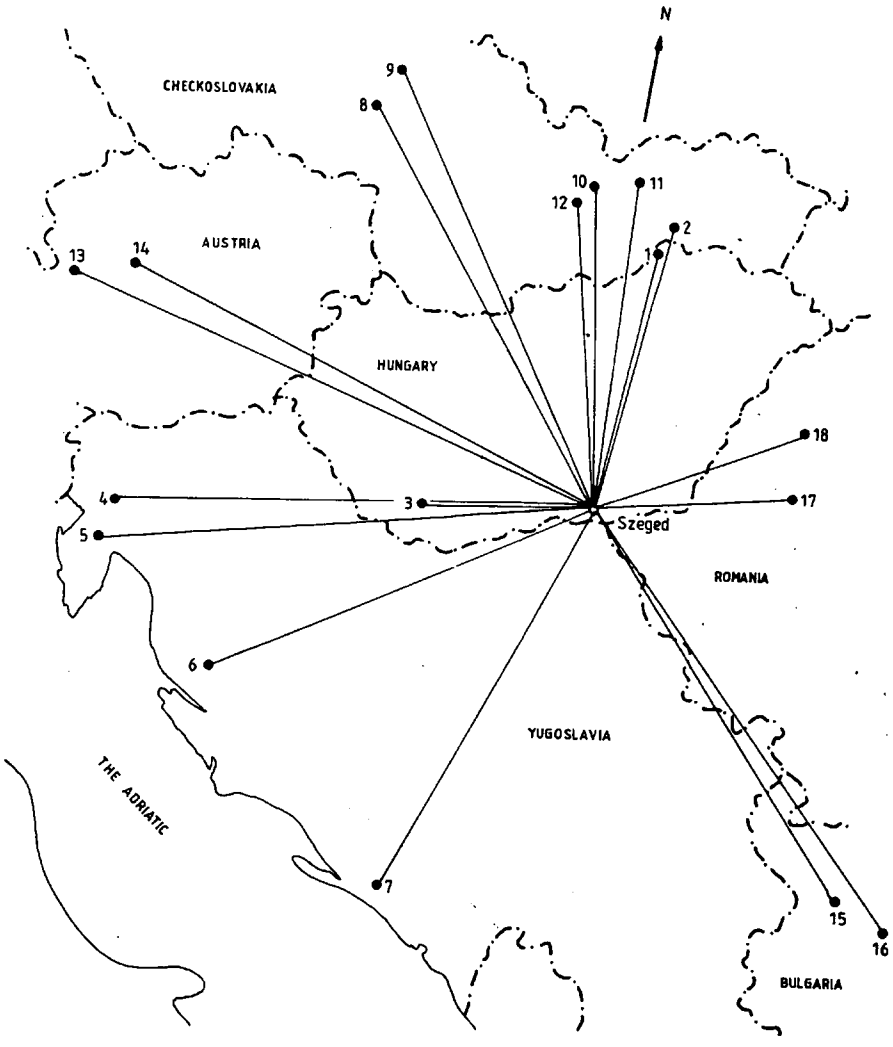


Figure 4. Localities of researches in 1983-85 for the new type of recent dripstone degradation

1) Aggtelek karst area (Hungary)
2) Gombaszögi cave (Czechoslovakia)
3) Mecsek karst area (Hungary)
4) Postojna cave (Yugoslavia)
5) Skocjani cave (Yugoslavia)
6) Gračac cave (Yugoslavia)
7) Popovo polje (Yugoslavia)16)
8) Moravia karst (Czechoslovakia)
9) Javoričko cave (Czechoslovakia)
10) Demänova cave (Czechoslovakia)
11) Vazecka cave (Czechoslovakia)
12) Bystra cave (Czechoslovakia)
13) Eisriesenwelt (Austria)
14) Dachstein Karst (Austria)
15) Ledenika cave (Bulgaria)
16) Seeva Doupka (Bulgaria)
17) Caves surraundings Pades plateau (Romania)
18) Király-Erdő caves (Romania)

poorish dripstones and the relatively rare points of recent limestone accumulation explain why we could not meet the new type of degradation syndrome, in spite of the fact that at some places remains of demolished, dissolved dripstones could be observed. But these latter are not recent degradations; their formation evidently is due to permanent corrosion and/or erosion oricesses prior to the present time.

Czechoslovakia

In 1985 two exploration trips were conducted in Czechoslovakia. In both cases several caverns of the Morava karst near Brno were studied, namely Javoricko Cave in the North-Moravia karst, the Demanova Cave in the low Tatras, Vazec Cave in the walley of White-Vág river, the Bystra Cave in the southern side of the Low Tatras as well as Domica and Gombaszög Caves in the South Slovakian karst.

The most marked devastation of the new type of dripstone degradation could be observed in Javoricko and Gombaszög Caves. There is also a considerable dripstone degradation (2—3 times greater than found in the Aggtelek Caves) in Freedom-Caves in Demanova, especially the middle- and upper levels of the cavern. The same can be said of Vazec Cave, while the redissolution of dripstones in Bystra Cave and Domica is somewhat weaker. There is no considerable recent degradation in the two thoroughly studied caverns of the Morava karst (in Caves Amateurska and Katerinska) — true, in these caverns the recent dripstone formation is rare.

Practically there is no difference in the climate of the caverns in Czechoslovakia. Therefore the marked difference of the new type of dripstone corrosion among caves must be looked for in the diversity of other conditions. In order to explore the really working conditions we had to study the *extent of vegetation coverage of karstic surfaces over the caves and the depth of caves underground.* We found that both factors may play their part in the extent of cave corrosion and perhaps the depth underground is the more important.

We know that a clausal interdependence system relying upon some observed data cannot be regarded as deciding, however, we describe our observations on the ground that similar experiences in the Yugoslavian and Roumanian karsts exhibit identical trends. Summarizing: it seems *the thicker is the soil layer over the karst and the deeper are the roots of the macro-vegetation there (trees in leaf) the more frequent and marked is the new type of dripstone redissolution.* According to the present state of knowledge it is probable that the role of pine-wood forests differ from that of others' (oak, beech, hornbeam etc.).

Another aspect of the correlation can be that *the less is the depth of the cavern underground* the more frequent can be the new type of dripstone degradation.

Naturally, these general relations are mostly of hypothetical character and further investigations are to be carried out. Even now there are exceptions contradicting these rules. But this time we think that in spite of exceptions the interdependence between surface and cave, as shown in Figs 5 and 6, seems to be fairly real.

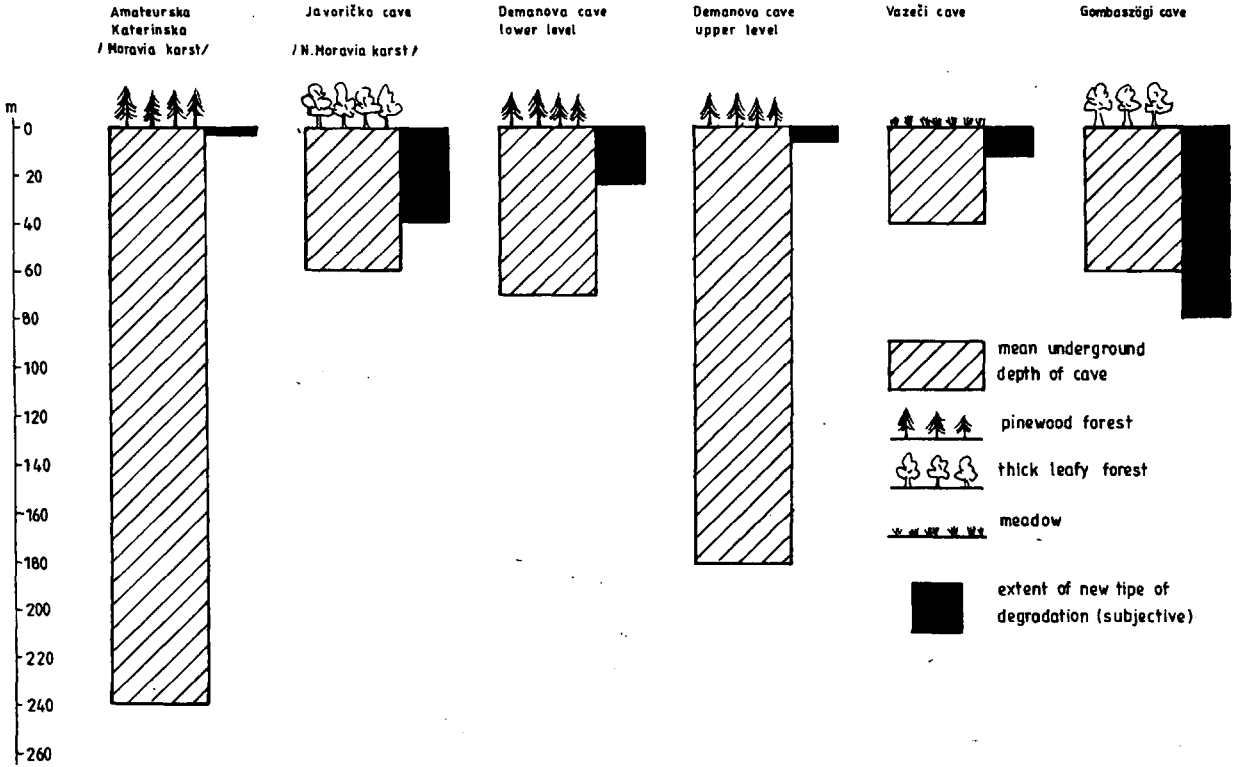


Figure 5 Supposed interdependence between underground depth, type of vegetation coverage and recent state of dripstone degradation in some cave system in Czechoslovakia (original)

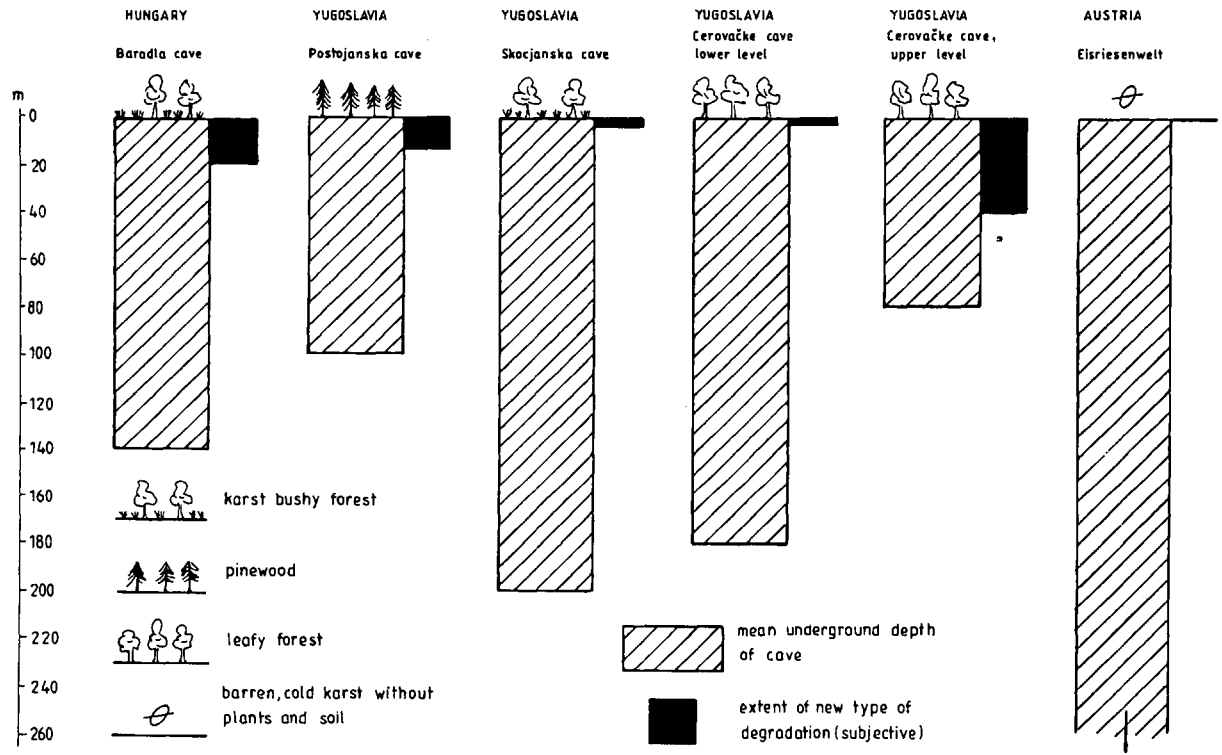


Figure 6 Supposed interdependence between underground depth, type of vegetation coverage and recent state of dripstone degradation in some cave system in Hungary and abroad (original)

Roumania

Two times, in 1984 and 1985 on location observations were carried out in Roumania, in the valley of Speedy-Körös river. The caves more thoroughly examined were: *Biro Lajos* Cave in Királyerdő where quite recent, mainly embryonal dripstone corrosion syndromes were found; *Rév Cave* where beside oozing of corroding water, forming beds of dissolution, a rather marked softening of the dripstones was experienced. At present this can be explained so that the aggressive solution got into the material of the dripstones and brought about changes in the texture itself. A quite similar occurrence was found in the upper level of Cerovacke Cave in Croatia. The new type of dripstone corrosion was found — what is a surprise — in the very beautiful light stalagmites in *Bear Cave* in the Bihar mountain, as well as in *Mikula Cave* in the area of the Pades plateau, where the traces were quite obvious not only on some stalagmites but on stalactites, too.

Bulgaria

Several caves were investigated here and the results varied. Coming down from Vratschanska plateau to the entrance of *Pestere-Ledenika*, a cave of about 600 m length was examined (the level difference between the lowest and highest points was 56 m) but no traces of the new type of degradation were found. Anyway, the cave is rather poor in dripstones, their recent formation is also restricted, scarcely any dripping of water was found at a few points.

Near Teteven in the Balcans the two-level *Geadezniska* Cave was examined (the level of difference between the floors is only 15-20 m) where a few dripstones and peastones could be found only at the upper level and no traces of redissolution observed.

However, in the *Seeva Doupka* Cave near Jablanica settlement (discovered in 1883 and open for tourist) the studied syndrome could be distinctively found at three places. This cave is rich in enormous dripstone formations therefore it is even more astonishing that most of the formations are aged and active developing stalagmites could hardly be found. However, recent dripstone degradation appeared here on the rare, recently formed white dripstone spots.

Yugoslavia

Special care was taken to control the occurrence of the studied syndrome here. Not only because here one can find enormous karstic areas and huge caverns (the karstic area in Yugoslavia is about 90 000 km2) but also we could count upon the air currents coming from the Mediterranean together with the precipitation exerting effects different from that in the centre of the continent what can be reflected in the pecularities of the corrosion degradation of the caves. These in view we tried to

make explorations in caves of various parts of the country, namely in Slovenia, Croatia and Bosnia and Herzegovina.

The *Postoina Cave* (Postojnska-jama) is one of the oldest and most frequented caves in Europe, with big tourist traffic today, inside electric train transport. At many places, deep in the cave far from the entrances recent degradation syndrome was found, the frequency and order of magnitude of development similar to that in Hungary.

This cavern offered excellent possibility to control the dripstone surface „before soot", since during the Second World War Slovenian partisans set fire the ammunition depo of the Fascists, which was hidden in the cave and the big fire underground covered everything with black soot a few hundred meters back from the entrance. In spite of a very careful study, however, under the black cover, the age of which is well known, not a single corroded dripstone was found, proving that before the forties type of redissolution of dripstones did not occur.

In the gigantic underground caves of *Skocianska* caverns recent dripstone redissolution was found only in caves of the Silent cavern (Ticha-iama) near the surface but not in the deep-lying main channel. True, here the formation of dripstones is rather poor and because of the sometimes 60—80 rise of the water level (the redamming effect of a tight syphon system) it would be very difficult clearly to state the reason of a possible degradation.

The *Cerovacka Cave* near the town Gracac in Croatia proved to be a fairly favourable place for researches in dripstone degradation because this is a two-level cavern, the floors of which are almost exactly over each other and there is a 90—100 m level difference between the two floors.

In the upper level of the Cerovacka Cave there is a large number of dripstone formations in the big cavities, most of them in active development even today. Here the new type of degradation has done enormous devastation. Here we could find not only corroded crates and corrosion canyons starting from them but also a very peculiar softening of dripstones embracing the covering crust of the calcite material of some stalactites and stalagmites in a few centimetres. This interesting phenomenon is not accompanied by morphological changes of dripstones. We can put our finger into the material of the dripstone which is apparently unharmed, with normal colour, formas if it were soft soap paste (see photos 36—41). Laboratory results of the dripstone material softened postgenetically are given in Chapter IV of this paper.

In the lower and younger level of Cerovacka Cave (we think Rüss-Würm Interglacial) there is much less dripstone than in the upper and we have found scarcely any developing ones. Practically there is no dripstone degradation either in the form of redissolution of the bed or softening of the dripstones. Seeking the cause of this we think that it cannot be ascribed to the damages caused by the stream erosion since there is no living waterflow here — even at times of the highest water not a single drop of the water of Gracaci Polje gets here. Namely there is a third deeper (so far unexplored) level assuring the water conducting of the Holocene.

In Southern Bosnia-Herzegovina, at the border of Popovo Polje is the *Zavala*

Cave under completely barren karr plateaus without soil or vegetation. This is an ancient — today inactive — sump cave with fine dripstones. But the traces of recent degradation are rare and weak here, what can be explained somewhat by the fact that recent growth of the dripstones proves a low level of lime accumulation dynamism. Probably this is connected with the remarkable erosion of the karstic surfaces.

Hungary

Obviously in the Hungarian caverns the new type of dripstone degradation is rather considerable, true, its frequency varies. The most marked redissolutions are in some caves in the Bükk mountains (e.g. Létrásivizes Cave), in certain areas of the Baradla in Aggtelek this syndrome is weaker but can't be disregarded (see photos 2—8), it has appeared in the Abaliget Cave and on some dripstones in the Peace Cave.

To tell the truth, we can't unequivocally decide that this on that cave is characterized by a certain frequency of occurrence and/or degradation. So it is very difficult to compare these caves since regarding only a single cavern (e.g. Baradla) the extent of damage widely changes by chambers or by sections. In long corridors rich in dripstones there are hundreds of meters where no recent redissolution syndrome can be found and then, in a single chamber there are a dozen places where the syndrome is apparent.

Three-four years of study of this syndrome are a very short time even to decide whether *since the first observations places of recent occurrence have grown in number or the extent of known forms of redissolution have increased.* These are questions demanding a sure answer soon but at present we cannot say anything sure. True, in our standard caves we almost always find newer earlier unseen damages of dripstones, but we do not dare to decide even for ourselves whether these are recent ones or not. Perhaps they could have been found a few years earlier but we not notice them. Namely, our eyes are getting accustomed to catching sight of the dripstone degradation syndrome and we, having already gained experience, can notice the phenomena in an unknown for us cave while others do not know exactly what is to be looked for.

In the X-ray Laboratory of the Department of Petrography and Geochemistry, University of Szeged, Professor J. Mezősi made the X-ray diffractometry analysis of the materials of softened dripstones gathered in Vazecki Cave. (Already?) no considerable contamination was found.

Researches for causes of the syndrome of the new type of dripstone corrosion

After the first observations of the syndrome naturally the problem of cause(s) stood before us. It was quite obvious to think of an indirect effect of acidic rains

(and/or acidic precipitation) since we already knew then that the acidic precipitation affects the soil, the life condition of microorganisms in the soil and even the macrovegetation growing there (grass, trees, bushes, etc.) suffers a lot. When noticing the phenomenon, the composition of several cave dripping waters was examined and their German degrees of hardness was 4—5 degrees less than that of the dripstone — building stalagmite waters of the same type, studied earlier. At the same time pH values of waters in the soil of a few dolines of Mount Bükk and the Aggtelek karst were generally found one grade less than the earlier measured pH values.

In view of all this as a first step we can explain the syndrome in the following way: the effect of acidic rains, the increasing degree of acidicity of the soil, the rearrangement or even dissolution of some chemical substances in the soil create new comfort relations for the soil microorganisms in the bioactive level of the soil what disturb the population, virulency and life functions of micro and/or macro-biological organisms in the soil and their equilibrium is so much overbalanced that the usual level of carbonic acid production of the soil drops. If this happens, the partial pressure of CO_2 in the soil spheres can markedly decrease, therefore the oozing precipitation waters change into only a weaker carbonic acid solution, that is their limesolving capacity would be less. Perhaps solutions with low lime saturation can cause redissolution of dripstones in a cave. After repeated analyses at a later time of waters of stalagmites affected by the new type of dripstone degradation we get some impulse to modify and further develop our interpretation of the causes of the syndrome. E.g. it became clear that a few data of analysis on the softening of cave dripping waters do not show a trend since later at the same places the values of lime saturation were much higher. Other researchers as e.g. *László Maucha* and *Ferenc Cser* pointed out in their reports in my paper on the new type of dripstone degradation written in 1984 (see Legend) that these corrosion signs of dripstones could not be caused by the softening of karstic waters because these latter, in an experienced degree, do not change the chemical character of water lime aggressive.

Accepting, and thanking for, the valuable corrections of our experts in chemistry, it is quite natural that we hold as a working hypothesis that the redissolution of dripstones remains in some way in connection with the effect of acidic rains (deposit) upon karstic surfaces. We have a deciding argument supporting this — and it so far has not been denied or substituted by some other argument. This is the following: *The time of acidic rains and the appearance of the new type of dripstone corrosion syndrome coicide and the „after soot state" could unequivocally be proved.* Then remains only to collect newer and newer observations and analytical data, then, relying upon these to look for that real interdependence by which the effects of a so characteristic for our era contamination of the outer sphere go deep down under the earth, to the horizon of dripstone caverns.

The following part of the paper summarize the most important scientific information about the explored caves and karstic surfaces in Hungary and abroad.

Recent changing trends in the chemical characteristics of karstic waters getting to dripstones

There are abundant data on the chemical composition of dripping waters both in Hungarian and foreign literature, among these there are lots on results of time sequence investigations, first of all in Aggtelek. All these data and sequences unequivocally prove that the chemical composition of waters getting to dripstones move in a very wide scale both in space and time. That is there can be a considerable difference between the values of volume of some chemical constituents, pH of karstic waters both when comparing simultaneously the different places of dripping and between water samples taken from the same place at different times. This is, of course, a consequence of that the waters oozing into rock layers above the caves, depending on the season, type and thickness of the soil, type of vegetation, duration of oozing, conditions of evaporation and airing of the soil are of considerably different composition, since waters get their own chemical characteristic in cells of soils covering the karsts which produce widely changing qualitative and quantitative chemical processes time by time and place by place.

To illustrate this data in Table 1 deserve some attention.

The comparison of these data makes not only possible to state that the chemical characteristic of water samples gathered at different places and/or times can be very widely various but also that there may be a kind of trend in the change of the proportion of certain ions. The progressivity is the most striking with the sulphate, nitrate and perhaps chloride ions but in the calcium and hydrocarbonate ions of water samples analyzed in March 1982 there was a marked decrease as compared with water samples gathered in Baradla and the Peace Cave in 1957 and 1960.

In 1984-85 the composition and changes in composition, respectively, of dripping karstic waters were examined at several points. We tried to repeat our experimental results as places where exact analytical data were obtained several decades earlier. These were first of all in Baradla Cave in Aggtelek where *Rezső Maucha* carried out water analyses of the dripstones „King's Well" and „Beggar". Taking these more than fifty year old data as etalons, the perhaps trend-like changes in present time water composition characteristics measured there can be taken as safe much more than if we have samples taken in some years' time. (See Tables 2 and 3 and Figures 7 and 8.)

Data in Table 2 show that much more dissolved limestone can be found in the karstic water of King's Well in summer than in winter. The sulphate root unequivocally grew as compared with the 1929 etalon value (a growth of 400—600%) but rations of the nitrate and chloride content change so widely that they can be rejected as a basis for a trend.

Data of analysis for „Beggar" summarized in Table 3 essentially support the above. Water samples taken in November and March are relatively soft while karstic waters from the end of April and August are hard. The amount of sulphate ions was manifold of that of the etalon while the ration of nitrate ions is of various magnitude. However, there was more chloride in the karstic water.

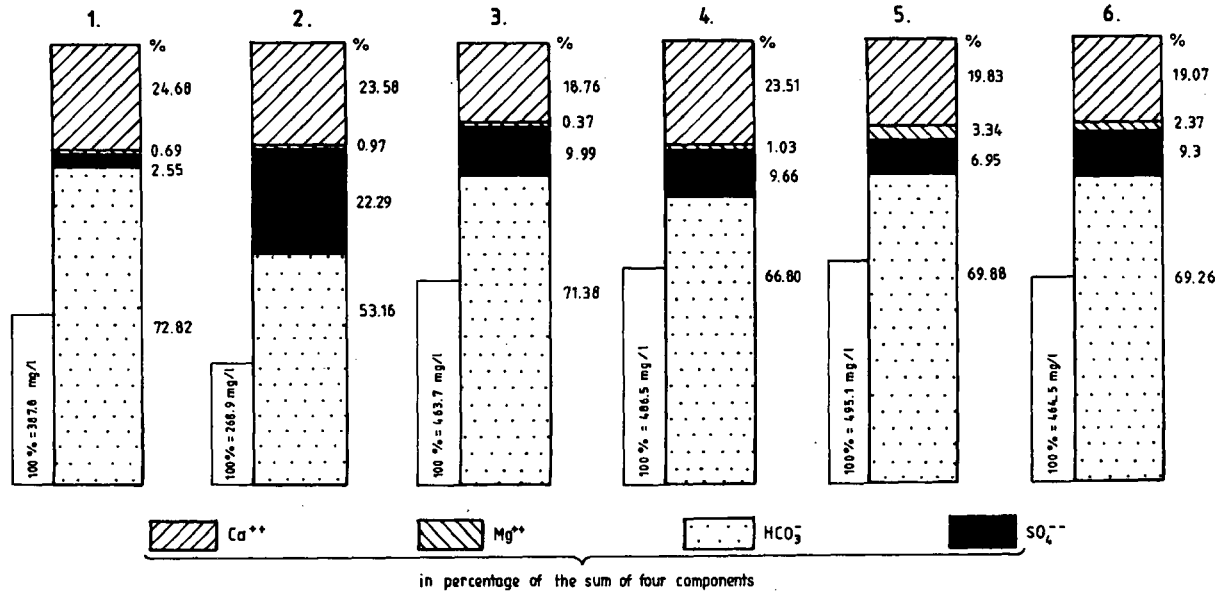


Figure 7 Water of „King's Well" dripstone basin (Aggtelek, Baradla cave)

1 = 30.07. 1929. (data by *R. Maucha)*
2 = 30.03. 1984. (data by *Csernavölgyi-Major)*
3 = 15.03. 1985. (original)
4 = 26.04. 1985. (original)
5 = 20.08. 1985. (original)
6 = 27.10. 1985. (original)

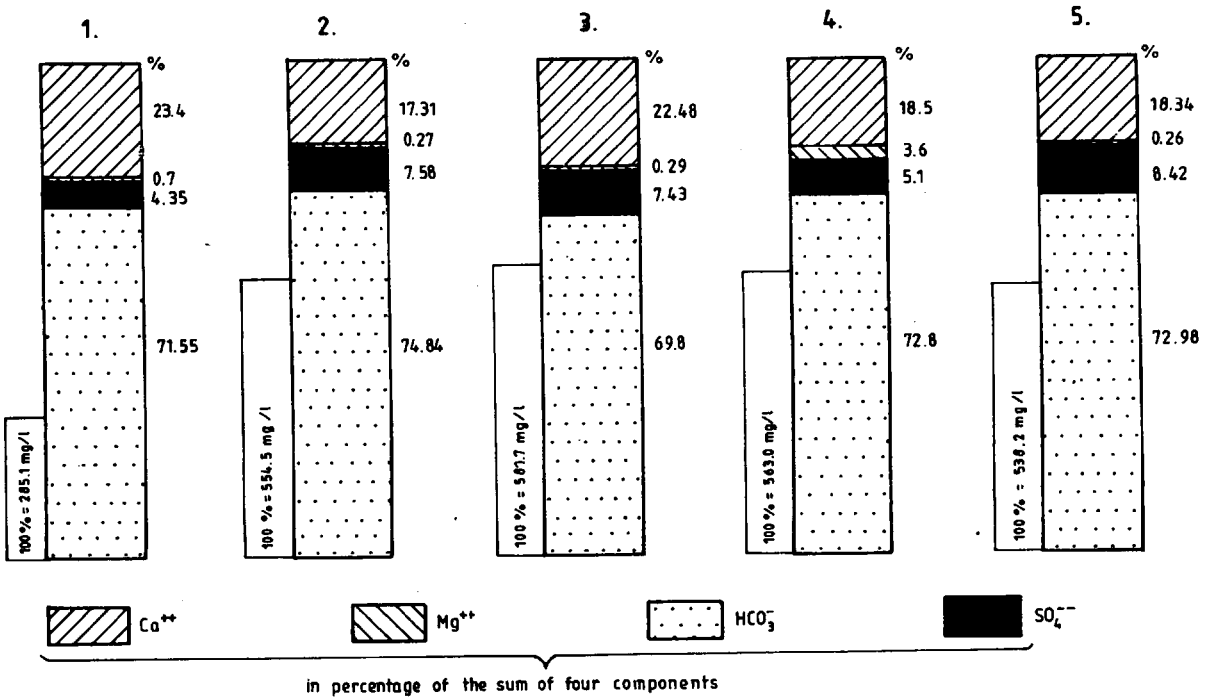
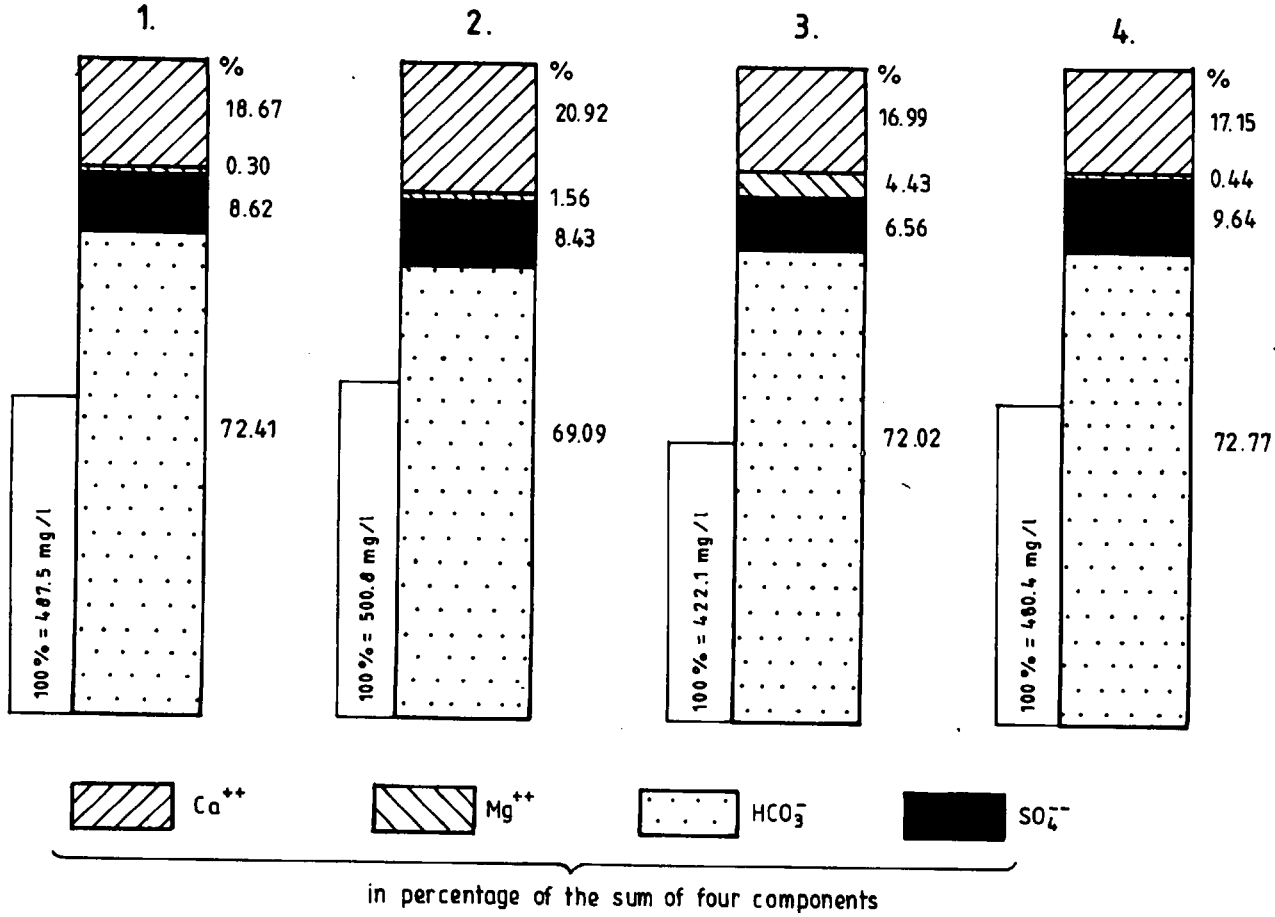


Figure 8 Water of the stalagmite „Beggar" (Aggtelek, Baradla cave)

1 = 29.10. 1929. Etalon (data by *R. Maucha)* 2 = 15.03. 1985. (original)
3 = 26.04. 1985. (original) 4 = 20.08. 1985. (original)
5 = 27.10. 1985. (original)


1.
2.
3.
4.
%
18.67
0.30
8.62
72.41
20.92
1.56
8.43
69.09
16.99
4.43
6.56
72.02
17.15
0.44
9.64
72.77
100 % = 487.5 mg/l
100 % = 500.8 mg/l
100 % = 422.1 mg/l
100 % = 480.4 mg/l
Ca++
Mg++
HCO3-
SO4--
in percentage of the sum of four components

The information given in these tables is visually shown as percentages of the four most characteristic chemical components. The 1929 norms are given in both figures as the first column. The other columns have a part coloured dark indicating the growing thickness of the „sulphate field".

Similarly we gathered and analyzed water samples in the research period of an eroded standing dripstone with channelled sides near the entrance of „Fairy Land", a stalagmite formation in the Baradla Cave attacked by recent corrosion degradation. 'Water samples taken and conserved duly were analyzed in Szeged in the Water Laboratory of Lower Tisza Water Authority by *Dr. E. Fekete* and coworkers. Results are shown in Table 4 and Fig. 9.

Unfortunately there is no earlier data on the water of this dripstone so it is impossible to decide upon a trend. The time elapsed between the examinations is about seven months what is a very short time to decide on any characteristic changes. Water continuously drips upon the dripstone (even in time of the longest cave „droughts") under a karstic surface covered by thick soil and leafy forests, so the water supply is fairly even. Perhaps the fact is connected with this that in contrast to other dripstones there was not a characteristic summer and winter difference between either the pH values or degrees of water hardness. Obviously the study must be carried on and extended to other components (perhaps trace elements) and the periods of taking samples must be accompanied with determining the amount of dripping.

The most important chemical parameters of samples of stalagmite water corrosion in caverns in Czechoslovakia, gathered 5—8 June 1985 are given in Table 5 Fig. 10. We note that a comparison with a winter water sample series would be very useful together with old time etalon values of the same area. It is a pity, so far we could not get these, although researchers of the Academy Institute in Brno *(Jan Pribyl, Jaroslav Vasatko)* and the scientific leaders of „Ustredic stájnej ochrany prirody" in Lipótszentmiklós promised us to look for and send some data of analysis. Anyway, after some years to gather comparison material from the same places seems desirable.

Data of analysis of waters gathered from dripstones in Czechoslovakian caves attacked by recent corrosion unequivocally show that *degrading karstic waters have a very great sulphate content.*

Figure 9 Water of a degrading dripstone (Aggtelek, Baradla cave)

1 = 15.03. 1985. (original) 2 = 26.04. 1985. (original)
3 = 20.08. 1985. (original) 4 = 27.10. 1985. (original)

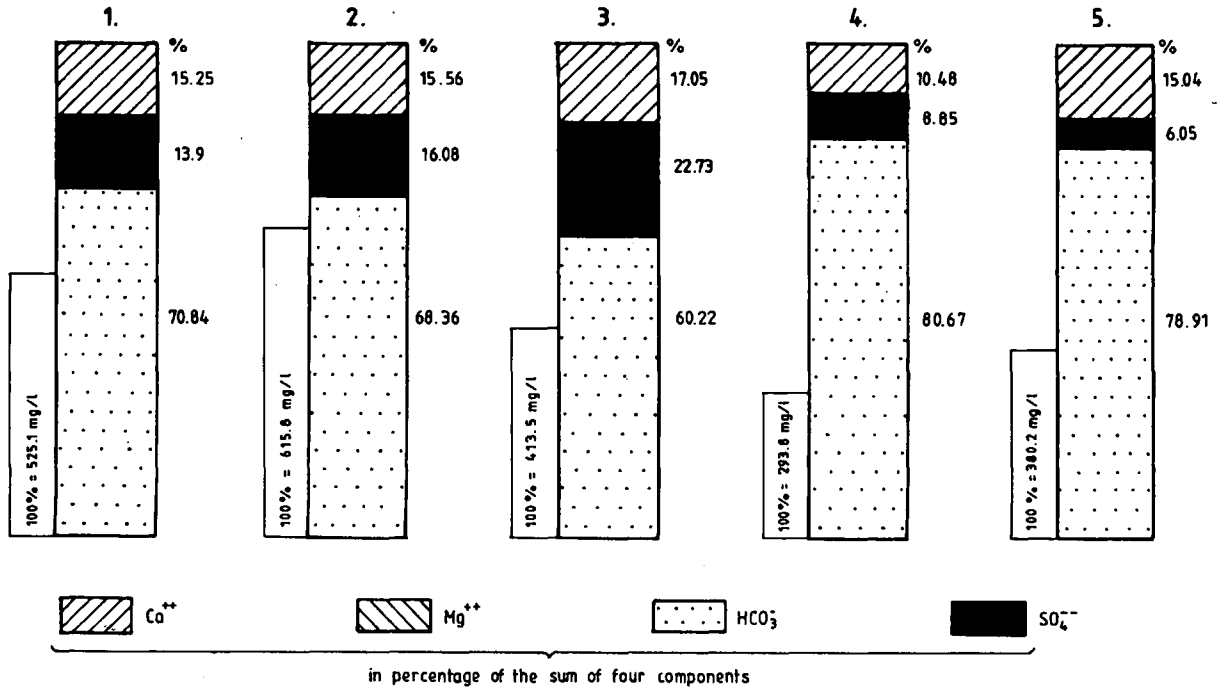


Figure 10 Waters of degrading stalagmites (caves in Czechoslovakia)

1 = Amateurska Cave, Moravia karst 05.06.1985. (original)
2 = Javoricko Cave I. N. Moravia karst 06.06.1985. (original)
3 = Javoricko Cave II. n. Moravia karst 06.06.1985. (original)
4 = Demanova Cave, Low-Tatra 07.06.1985. (original)
5 = Vazecka Cave, High-Tatra region 08.06.1985. (original)

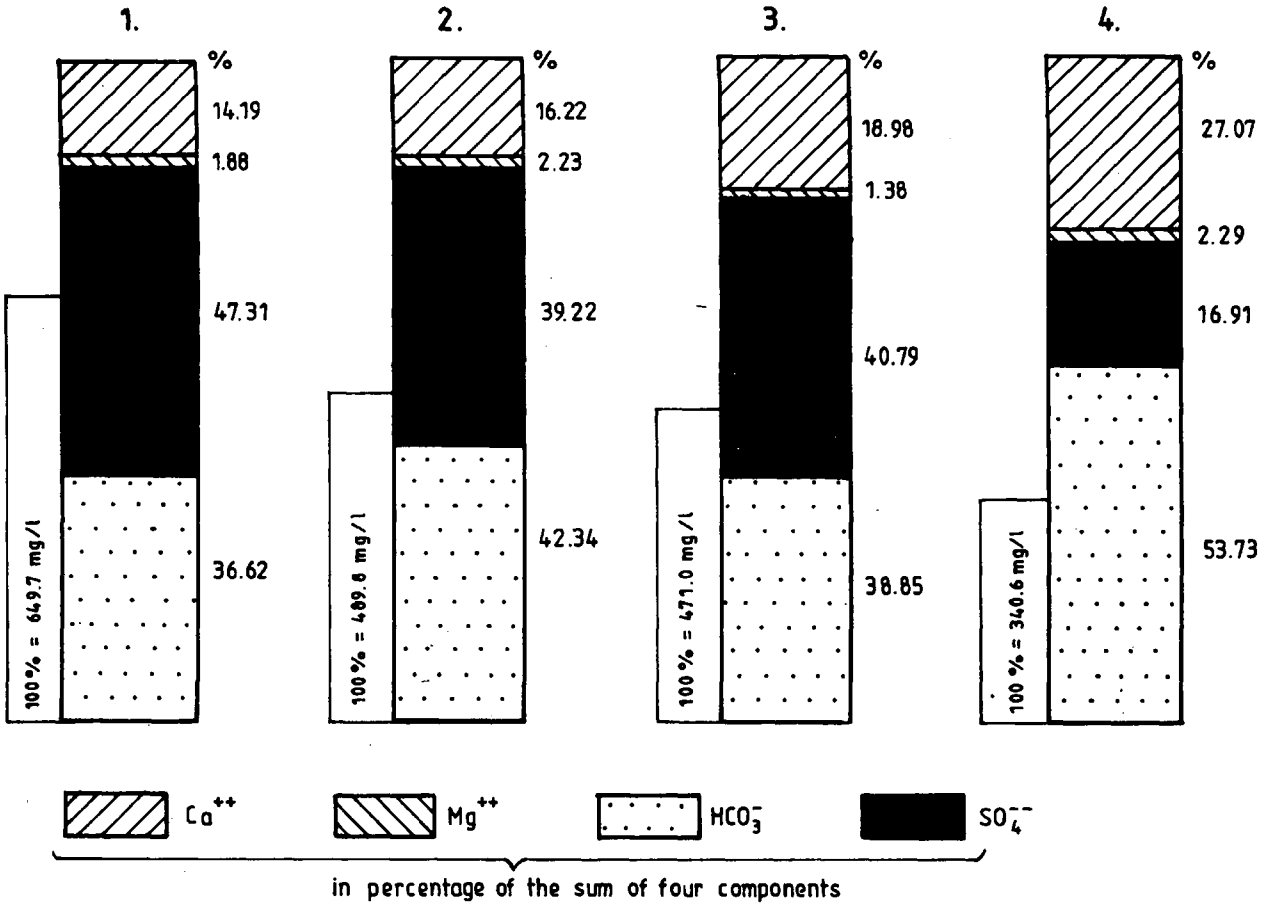


Figure 11 Water samples of Létrás water-cave (Mount Bükk) calculated according to data by *L. Lénárt*

1 = sampling place No.5. 22.09.1979. 2 = sampling place No.5. 03.11.1979.
3 = sampling place No.6. 22.09.1979. 4 = sampling place No.6. 03.11.1979.

Since almost in all (not documented here!) water samples gathered from points of the new type of dripstone degradation the sulphate content is much more higher than in karstic waters of classical composition (see Rezső Maucha: Chemical analysis of the waters in Aggtelek. Hidrológiai Közlöny Vol. X, 1939 pp 201—207) we tend to be convinced that *recent syndromes of dissolution are caused either by increased sulphate concentration or indirectly by the same causes which lead to an increased sulphate content of karstic waters.*

In this connexion we must remember that László Lénárt documented with extensive and very careful water analysis in Létrási water cave in the Bükk mountain where there is recently very weak dripstone formation and very strong redissolution of dripstones, and the sulphate content of karstic waters there is much higher than in all the caves examined by us. It is almost natural, since the Bükk mountain is surrounded by the Miskolc-Diósgyőr-Kazincbarcika-Ózd-Bélapátfalva etc. industrial region what means a considerable contamination of the soil and air. The main results of analysis of sample places No. 5, 6, 9 and 10 which represent very well the chemical characteristic of the dripping waters in Létrási Cave are shown in Table 6 and Figures 11 and 12. (Paper by *L. Lénárt:* Water chemistry study of Létrási Cave, Karszt és Barlang, 1980 pp 57—64.).

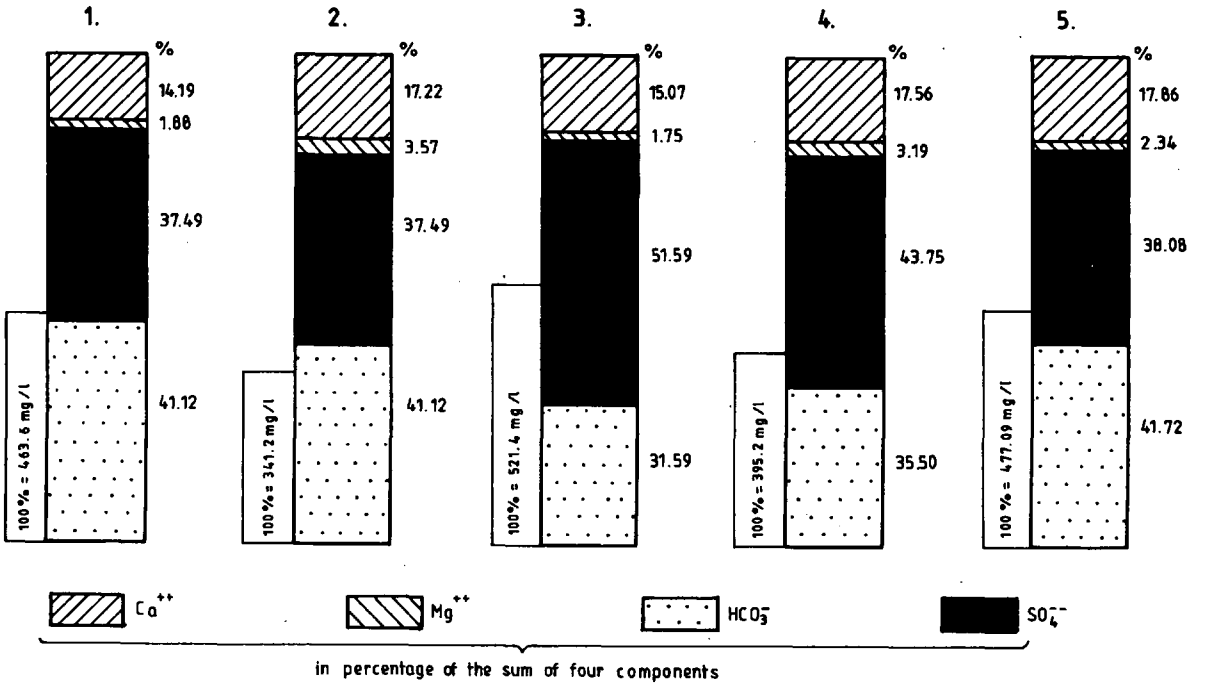


Figure 12 Water samples of Létrás water-cave II. (Mount Bükk) calculated according to data by *L. Lénárt*

1 = sampling place No. 9. 22.09.1979.
2 = sampling place No. 9. 03.11.1979.
3 = sampling place No.10. 22.09.1979.
4 = sampling place No.10. 03.11.1979.
5 = mean of 19 samples 11.03.-08.09.1979.

Table 1.

COMPARISON OF CHEMICAL ANALYSIS OF CAVE DRIPPING WATERS AT THE SAME TIME AND AT VARIOUS TIME

Place of the water sample	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
Datum of examination	10. 02. 1960.	21. 08. 1960.	05. 03. 1982.	20. 11. 1957.	05. 03. 1982.	22. 11. 1957.	19. 08. 1960.	06. 03. 1982.	22. 09. 1979.	22. 09. 1979.	26. 11. 1929.	23. 07. 1962.	08. 07. 1981.	07. 03. 1982.
pH	7.1	7.3	6.6	7.2	7.0	7.2	7.1	7.0	6.9	6.9	7.5	7.2	7.0	6.9
Ca^{++} mg/l	103.0	124.0	86.0	92.0	83.0	101.0	122.0	99.0	92.2	98.6	54.2	106.0	111.0	83.8
Mg^{++} mg/l	1.0	2.2	1.4	4.5	2.2	1.9	1.9	3.7	12.2	11.3	3.2	2.1	3.1	3.3
HCO_3^- mg/l	298.0	370.0	281.0	322.0	267.0	288.0	380.0	235.0	238.0	226.0	174.0	303.0	310.0	266.0
SO_4^{--} mg/l	14.0	9.2	47.0	8.5	33.4	12.2	17.0	27.7	307.0	250.0	16.1	8.9	24.1	29.9
Cl^- mg/l	3.0	3.6	8.2	4.1	6.8	2.3	2.1	16.1	11.0	11.0	3.6	5.0	14.3	6.5
NO_3^- mg/l	16.2	14.8	43.2	13.7	40.9	12.2	14.2	9.7	5.9	2.2	1.0	4.2	20.3	23.5

1, 2, 3 = Baradla-cave, „Csipkéskút" (L. Jakucs) 4,5 = Baradla-cave, „Kínai-pagoda" (L. Jakucs) 6, 7, 8 = Béke-cave „Amfora" (L. Jakucs) 9 = Létrási-vizes-cave, 4th point (L. Lénárt) 10 = Létrási-vizes-cave, 7th point (L. Lénárt) 11 = Baradla-cave, „Dessewffy kútja" (R. Maucha) 12, 13 = Postojanska-cave, „Kálvária" (L. Jakucs) 14 = Domica-cave, „Indiai pagodák terme" (L. Jakucs)

Table 2.

DATA OF ANALYSIS OF IONS EXPRESSING A TREND IN THE CAHNGE OF WATER COMPOSITION. „KING'S WELL" DRIPSTONE BASIN IN THE BARADLA CAVE

	30.07.1929. (R. Maucha) ETALON	30.03.1984. (Csernavölgyi-Major)	15.03.1985. (Jakucs-Franczia)	21.03.1985. (Jakab-Major)	26.04.1985. (Jakucs-Franczia)	20.08.1985. (Jakucs-Franczia)	27.10.1985. (L. Jakucs)
Ca^{2+} mg/l	93.4	63.4	87.0	64.3	114.4	98.2	88.6
Mg^{2+} mg/l	2.7	2.6	1.7	12.7	0.5	3.3	2.4
HCO_3^- mg/l	282.4	143.0	331.0	267.3	325.0	246.0	321.7
SO_4^{2-} mg/l	9.9	59.9	44.0	46.9	47.0	34.4	43.2
NO_3^- mg/l	12.3	— ?	20.2	— ?	11.4	17.9	8.2
Cl^- mg/l	2.7	25.4	7.1	1.8	14.4	21.0	5.8

Table 3.

DATA OF ANALYSIS OF IONS EXPRESSING A TREND IN THE CHANGE OF WATER COMPOSITION. STALAGMITE „BEGGAR" IN THE BARADLA CAVE

	29.10.1929. (R. Maucha) ETALON	15.03.1985. (Jakucs-Franczia)	26.04.1985. (Jakucs-Franczia)	20.08.1985. (Jakucs-Franczia)	27.10.1985. (L. Jakucs)
Ca^{2+} mg/l	66.7	96.0	130.8	104.2	98.7
Mg^{2+} mg/l	2.0	1.5	1.7	20.2 (?)	1.4
HCO_3^- mg/l	204.0	415.0	406.0	410.0	392.8
SO_4^{2-} mg/l	12.4	42.0	43.2	28.6	45.3
NO_3^- mg/l	8.5	14.2	1.8	17.5	8.2
Cl^- mg/l	1.5	7.8	6.6	9.3	4.5

Table 4.

KARSTIC WATER OF A STRONGLY DEGRADED STALAGMITE AT THE ENTRANCE OF „FAIRLY LAND" IN BARADLA CAVE

	15.03.1985. (Jakucs-Franczia)	26.04.1985. (Jakucs-Franczia)	20.08.1985. (Jakucs-Franczia)	27.10.1985. (L. Jakucs)
Ca^{2+}	91.0	104.8	71.7	82.4
Mg^{2+}	1.5	7.8	18.7	2.1
HCO_3^-	353.0	346.0	304.0	349.6
SO_4^{2-}	42.0	42.2	27.7	46.3
NO_3^-	13.5	9.0	8.5	14.8
Cl^-	7.1	15.5	11.3	9.9
pH	7.47	7.59	7.18	7.30

Table 5.

DATA OF ANALYSIS OF KARSTIC WATERS GATHERED FROM DRIPSTONES ATTACKED BY THE NEW TYPE OF CORROSION IN SOME CAVES IN CZECHOSLOVAKIA

	Amateurska cave 05.06.1985.	Javoričko I. cave 06.06.1985.	Javoričko II. cave 06.06.1985.	Demänova cave 07.06.1985.	Vazecka cave 08.06.1985.
$Ca^{2+} + Mg^{2+}$ mg/l	80.1	95.8	70.5	30.8	57.2
HCO_3^- mg/l	372.0	421.0	249.0	237.0	300.0
$SO2_4^-$ mg/l	73.0	99.0	94.0	26.0	23.0
NO_3^- mg/l	1.77	11.0	15.0	6.03	1.80
Cl^- mg/l	10.65	8.88	8.88	3.55	5.33

Table 6.

DATA OF CHEMICAL ANALYSIS OF THE KARSTIC WATERS OF LÉTRÁSI WATER CAVE IN MOUNT BÜKK (BY L. LÉNÁRT)

Number of the test place	5	5	6	6	9	9	10.	10.	Mean of 19 samples
Datum	22.09. 1979.	03.11. 1979.	22.09. 1979.	03.11. 1979.	22.09. 1979.	22.09. 1979.	22.09. 1979.	03.11. 1979.	08.09.—03.11. 1979.
pH	6.9	6.9	6.9	6.4	6.9	6.9	6.9	6.9	6.94
Ca^{++} mg/l	92.2	79.4	89.4	92.2	65.8	60.8	78.6	69.4	85.21
Mg^{++} mg/l	12.2	10.9	6.5	7.8	8.7	12.2	9.1	12.6	11.16
HCO_3^- mg/l	237.9	207.4	183.0	183.0	158.6	140.3	164.7	140.3	199.05
SO_4 mg/l	307.4	192.1	192.1	57.6	230.5	127.9	269.0	172.9	181.67
NO_3 mg/l	4.3	2.6	2.2	0.2	2.2	2.6	5.9	6.2	4.23
Cl mg/l	11.0	13.2	11.1	8.4	10.9	12.6	8.2	9.7	11.77

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VERGLEICHENDE KARSRBODENUNTERSUCHUNGEN IM GEBIRGE BÜKK UND IM KARST VON AGGTELEK IN UNGARN

ILONA BÁRÁNY—KEVEI

Lehrstuhl für Physischergeographie
A. József Universität, Szeged, 6722, Ungarn

Seit mehreren Jahren unternehmen wir systematisch analysierende Bodenuntersuchungen in den Karstgebirgen von Ugarn. Ziel dieser Untersuchungen ist der Nachweis der in den Karstböden Ablaufenden Veränderungstendenzen, beziehungsweise die Bewertung der Wirkung dieser Veränderungen auf die Karstkorrosion. Die im Jahre 1978 im Bükkgebirge begonnenen Untersuchungen (die für die weiteren Beobachtungen als Etalon dienen) wurden nach mehrjährigen Forschungen mit einen anderen vom Bükkgebirge abweichenden Bodentyp in Aggtelek ergänzt.

Die beiden Karstgebiete sind genetisch vom gleichen Typ, gewisse lithologische Unterschiede und die Abweichungen im Prozeß der Oberflächenentwicklung der Gebirge hatten Wirkung auf die Entwicklung der Böden. Die Karstböden der Bükkgebirge sind schwarze oder braune Rendsinen, es sind aber auch auf die Dynamik der braunen Waldböden hinweisende Varianten zu finden, abhänging davon, in welcher geomorphologischen Schicht oder Lage das Gebiet vorkommt. Im Karst von Aggtelek sind die Varianten der roten Karstböden und die Rendsinaböden häufig, im allgemeinen sind die reiferen, konsolidierteren Böden wie die Böden der Plateaudolinen der Bükkhochebene.

Die physikalische Zusammensetzung betrachtend gehören die Böden in die Ton— (0,001—0,002 mm), Schlamm— und Gesteinmehl— (0,002—0,05 mm) Fraktion, es kommt aber auch ein wenig Feinsand (0,05—0,1 mm) vor. Wenn wir die Karstböden von Aggtelek und Bükk vergleichen, dann sind beim ersteren die Ton— und Schlammfraktion in höherer Prozentzahl zu finden. Das Gesteinmehl beträgt in den Dolinen von Aggtelek etwa 50%, in dem Bükkgebirge etwa 60%. Die Abweichung der Schlammfraktion ist geringer, die Tonbestandteile sind stärker nachweisbar.

Solange in den Bodenproben vom Bükk der Anteil des Tons überall unter 10% bleibt, beträgt dieser Wert in den Böden von Aggtelek 15%. Diesen Unterschied kann man nicht vernachlässigen, da die Mehrheit der Bodenkolloiden zu dieser Körnchenkategorie gehören, und dies beeinflußt die Menge der an den Kolloiden gebundenen oder austauschbaren Ionen und die Wasserbindefähigkeit grundlegend. Die Menge des groben Gesteinmehls der Gesteinmehlfraktion in den Proben von Aggtelek beträgt das 2—2,5 fache des feinen Gesteinmehls. Nach den Untersuchungen in den Dolinen von Aggtelek verdoppelt sich die Menge des Tons in größerer Bodentiefe (es wurde bis zu 4,5 m gebohrt), was sich in noch größeren Tiefen weiter erhöht. Dieses hängt damit zusammen, daß hier das aus Feinfraktion

bestehende Material sich verdichtet. Nach den Messungen von *L. Zámbó* (1986) kann die Menge der Tonfraktion in 1,5 m tiefer Dolinenausfüllung auch schon 40% erreichen.

Die ökologischen Wirkungen kommen selbstverständlich in den Bodenschichten nahe der Oberfläche am meisten zur Geltung, somit beziehen sich unsere weiteren Untersuchungen auf die oberer Bodenschichten.

Nach den Untersuchungen in den Dolinenböden von Aggtelek weisen die pH—Verhältnisse bedeutende Unterschiede auf. Bei dem Vergleichen der KCl und pH—Werte läßt sich erkennen, daß der pH—Wert in den Plateaudolinen der Bükkgebirge am Dolinengrund niedriger ist als am anderen Teil des Berghanges, in Aggtelek haben wir in jeder Exposition niedrigere pH—Werte gemessen. Der pH—Wert des Bodens beeinflußt unter den chemischen Eigenschaften vorwiegend die biogene Aktivität. Mehrere Jahre lang haben wir die pH—Werte der Dolinenböden sowohl im Wasser als auch in KCl—Lösung untersucht. Von den beiden Werten ist der pH—Wert in der Wasserlösung in jedem Fall größer, da das KCl in der Bodenlösung eine neutrale Salzauflösung verursacht, dadurch wird der Boden sauerer. Der Unterschied zwischen den beiden Werten beträgt bei saueren Böden 0,2—0,5. Wenn dieser Unterschied größer ist, bedeutet dies, daß der Boden zu sauer wird, was für die Pflanzen Schädlich ist, hat aber große Bedeutung in der Herausbildung der mikrobialen Tätigkeit (*P. Stefanovits*, 1981.)

In einer Doline der Bükkgebirge (wo die antropogene Wirkung ausgeschlossen ist, da sie vollkommen geschützt ist) haben wir den pH—Wert im Jahre 1982 und 1984 analysiert, die Abweichungen zwischen wässerige und KCl—Bodenlösung betrug 0,2—0,6. In derselben Doline bewegte sich nach zwei Jahren die Abweichung des pH—Wertes zwischen 0,4—1,3, aber in den meisten Fällen hat sie den Wert 0,7 überschritten. Diese Änderung bedeutet eindeutig, daß der Boden immer saurer wird. Dieser Vorgang kann in diesen Karstböden mit der Ansammlung sauerer Humusanteile bzw. mit der Reaktion zwischen den ungebundenen sauren Gruppen und den Kationen auf der Oberfläche der organischen Stoffe erklärt werden. Dieser Vorgang vollzieht sich auch bei der Wirkung von sauren Humusstoffen in den kalkhaltigen Grundgesteinen. In den Dolinen von Aggtelek beträgt der Unterschied zwischen den beiden pH—Werten 0,8—1,8, was auf den stärkeren Säuerungsvorgang hinweist (Abb. 1., 2.). Hinsichtlich der Bindigkeit und der Humusstoffe haben wir in den Dolinen von Bükk höhere Werte gefunden.

Bisher haben wir keine Angaben über die Menge der Metallanteile gemacht, deshalb möchten wir jetzt darauf eingehen. Den Anteil an Zink, Kupfer, Magan und Eisen bei den Zwei unterschiedlichen Dolinenböden geben wir im ppm-Wert an (mg/100 g Boden). Der Zink— und Kupfergehalt in den Dolinen von Bükk ist im allgemeinen höher. Der Mangangehalt ist im N—S Querschnitt niedriger, aber im O—W Schnitt höher. Messungen hinsichtlich des Eisengehalt haben wir nur in den Dolinen von Aggtelek, Phosphorpentoxid und Kaliumoxid in den Dolinen von Bükk durchgeführt.

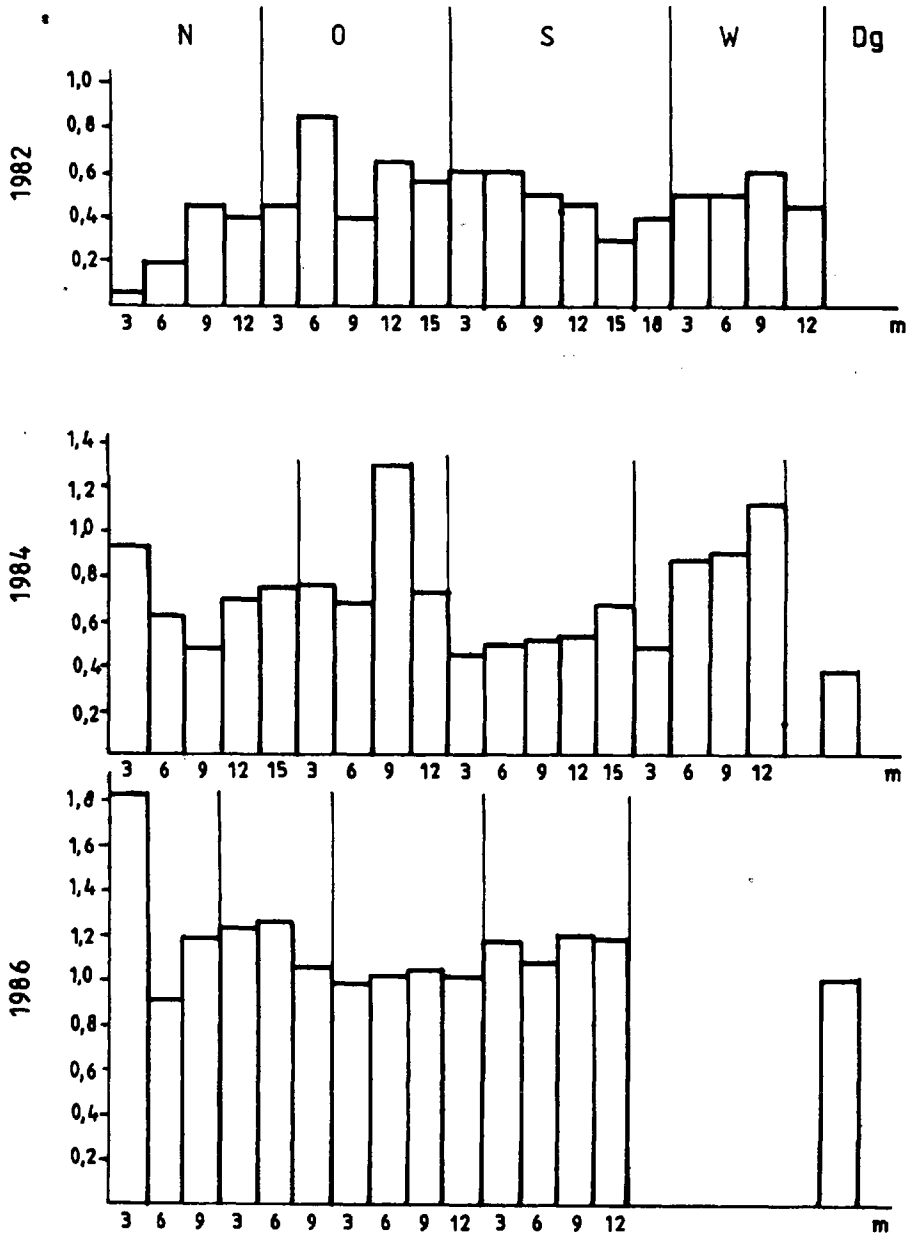

Abb. 1. Die Differenz zwischen pH Werten (H_2O) ind pH Werten (KCl) in einer Tiefe von 5 cm der Dolinen—Bodenschicht im Bükkgebirge in den Jahren 1982 und 1984, bzw. im Aggtelek—Gebirge im Jahre 1986. (N = Nordabhang, O = Ostabhang, S = Südabhang, W = Westabhang, Dg = Dolinengrund, 3,6,9,...m = Isohypsen aufwäarts vom Dolinengrund.)

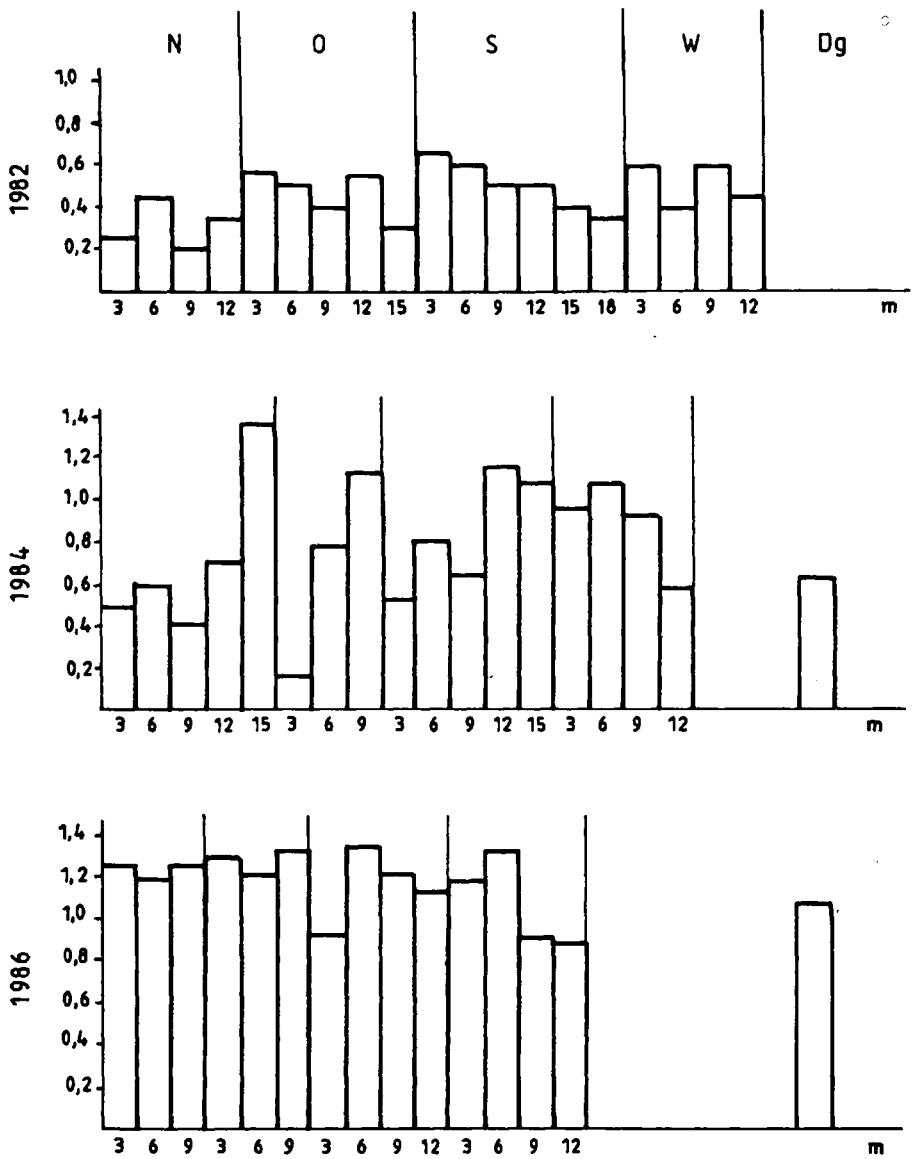

Abb. 2. Die Differenz zwischen den pH Werten (H_2O) und pH Werten (KCl) in einer Tiefe von 30 cm der Dolinen—Bodenschicht im Bükkgebirge in den Jahren 1982 und 1984, bzw. im Aggtelek—Gebirge im Jahre 1986. (Buchstabensynbole s. Abb. 1.)

Hinsichtlich der im Wasser löslichen Kationen bzw. Anionen kann man feststellen, daß in den Dolinen von Aggtelek die Ionelemente in geringerer Menge vorhanden sind als in den Dolinen von Bükk. Das entspricht auch der stärkeren Säuerungstendenz. Die Gesamtkationmenge ist wesentlich geringer am westlichen Berghang der Dolinen von Aggtelek im Vergleich zur Datenreihe der Dolinen von Bükk.

Wir haben aufgrund unserer Aufnahmen von Bükk (1978, 1984, 1985) die Korrelationsverbindung der Menge der im Wasser löslichen Kationen und Anionen auf den unterschiedlichen Dolinenhängen bewertet. Wir haben in jedem Jahr, in jedem Fall und bei jedem Hang mit mehr als 10 Daten gearbeitet, somit weist der Wert des Korrelationsfaktors über $r=0{,}62$ auf eine reale Verbindung hin (*Gy. Péczely*, 1979.). Im allgemeinen hängt die Menge der im Wasser löslichen Kationen und Anionen von der physikalischen, chemischen und biologischen Zustandsänderung der Böden ab, nach mehreren Jahren kann man aber gewisse Tendenzen beobachten. Man kann feststellen, daß in drei Jahren die Korrelationsverbindung der K^+ und Na^+ Ionen sich zu den Cl^- und SO_4^{2-} Ionen nicht wesentlich geändert hat, die Korrelationsfaktoren weisen auf dem nördlichen und südlichen Hang auf eine reale Verbindung hin. Im Falle der Magnesiunionen kann man eine ähnliche Tendenz auf dem westlichen Hang beobachten, hier ist aber der Wert der Korrelationsfaktoren niedrig, welches auf eine lockere Verbindung hinweist. Hinsichtlich der Ca^{2+} Ionen kann man mit der Pufferfähigkeit der auf Kalksteingrund herausgebildeten Böden erklären kann.

Wenn man die Korrelationsfaktoren der Dolinen von Aggtelek und Bükk vergleicht, ist die enge Korrelation der HCO^- Ionen mit den Ca^{2+} Ionen Mg^+ Ionen in den Dolinen von Aggtelek ersichtlich (Abb. 3., 4., 5.). In den Dolinen von Bükk weisen neben den Mg^+ Ionen die Na^+ Ionen eine Korrelation mit den HCO^- Ionen auf. Bei beiden Karsten kann man aber nachweisen, daß die Korrelationsverbindung der Cl^- und SO_4^{2-} Ionen mit den Kationen ungewiß ist oder es besteht keine meßbare Verbindung. In den Dolinen von Bükk hat sich in den letzten zwei der drei untersuchten Jahre (1984, 1985) diese Verbindung aufgelockert. Im Jahre 1978 war bei den meisten Datenaufnahmestellen zwischen der Menge der Kationen und Anionen eine enge Korrelation vorhanden. Die Abschwächung der Verbindung ist auch in diesem Fall auf den Säuerungsvorgang zurückzuführen.

Die physikalischen und chemischen Eigenschaften des Bodens wirken auf die biogene Aktivität, und dadurch auch auf die CO_2 Produktion im Boden. Die Bakterienpopulationen wurden in den Aufnahmen von 1985 in Bükk untersucht und die erhaltenen Ergebnisse werden zusammen mit dem Bodenfeuchtigkeitsverhalten bekanntgegeben (Abb. 6., 7.). Auf Grund unserer früheren bakteriellen Untersuchungen (I. Bárány—G. Mezősi, 1978) ist die Feststellung interessant, daß trotz des höheren Feuchtigkeitsgehalts die Bakterienzahl nur in 5 cm bodentiefe in dem N—Schnitt hoch ist. Am östlichen Hang erhöht sich die Zahl der Bakterien nur am Dolinenrand. Bei 30 cm ist die Zahl der Bakterien eindeutig niedriger als 1982.

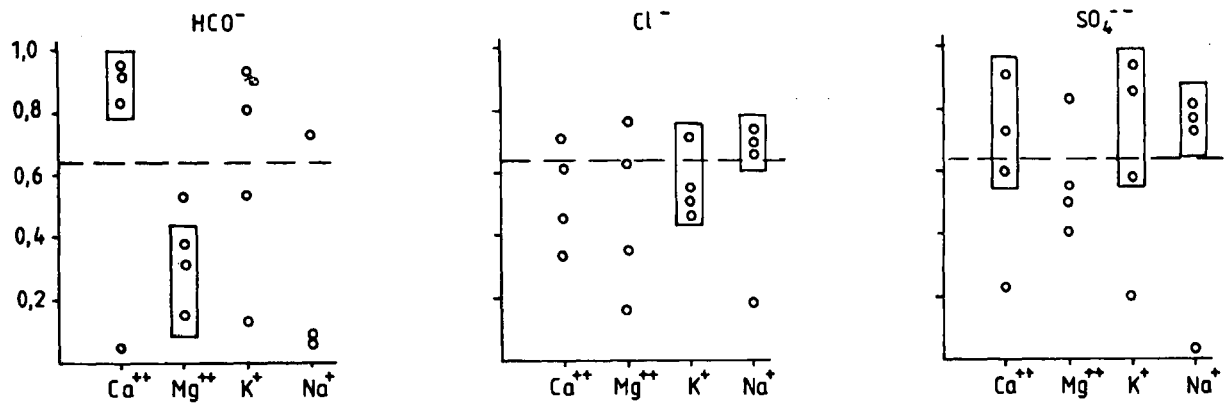

Abb. 3. Der Korrelationszusammenhang zwischen den wasserlöschlichen Anionen und Kationen in einen Doliner des Bükkgebirges im Jahre 1984. (Die *r* Werte, die zu den einzelnen Anionen und Kationen gehören, wurden nach den daten der Abhänge der vier Haupthimmelsrichtungen festgestellt.)

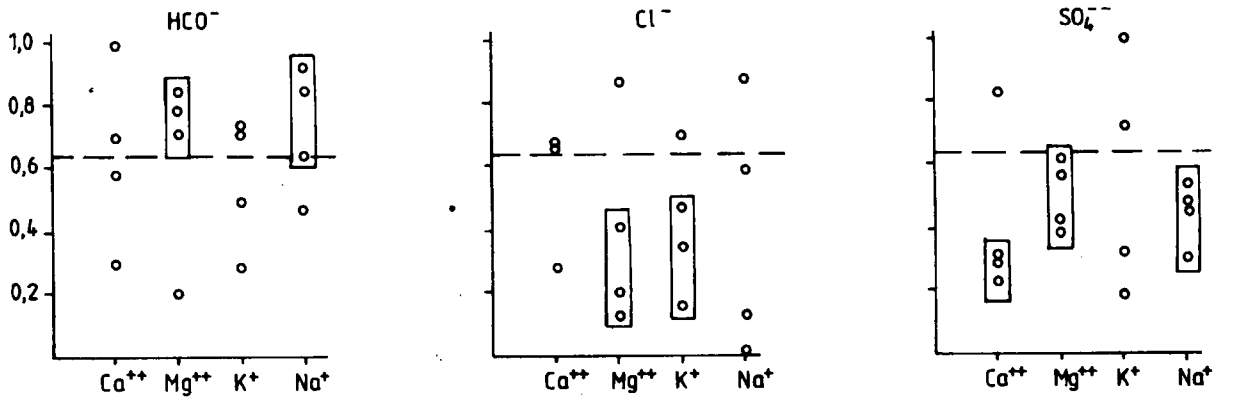

Abb. 4. Der Korrelationszusammenhang zwischen den wasserlöschlichen Anionen und Kationen in einer Doline des Bükkgebirges im Jahre 1985. (Für die Interpretation der *r* Werte s. Abb. 3.)

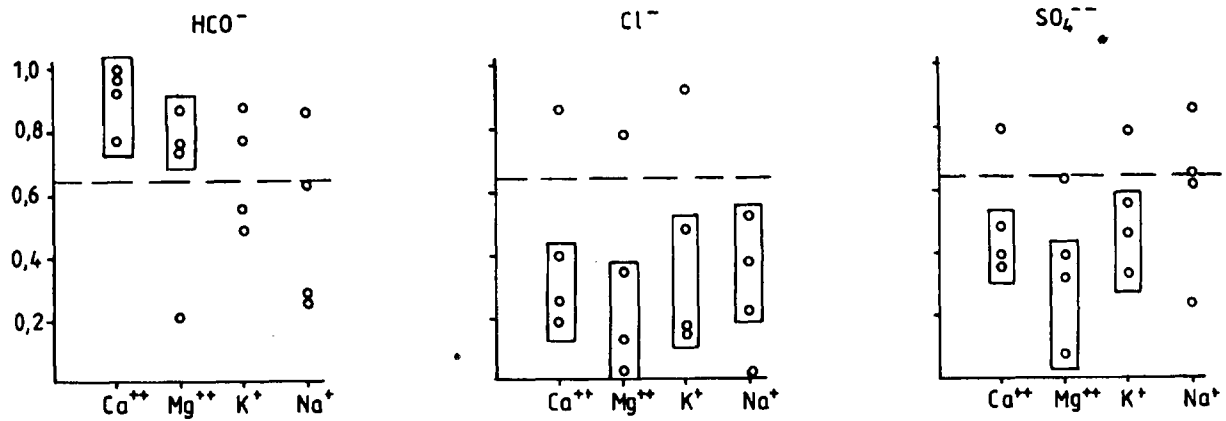

Abb. 5. Der Korrelarionszusammenhang zwischen den wasserlöschlichen Anionen und Kationen in einer Doline des Aggtelek—Gebirges im Jahre 1866. (Für die Interpretation der *r* Werte s. Abb. 3.)

Die bakterielle Tätigkeit bzw. die Anzahl der Bakterien ist abhänging von dem Bodenzustand. Bei den Bodeneigenschaften hängt die Durchlüftung des Bodens von dem Bindigkeitsgrad ab. In den Dolinen von Bükk finden wir die Bindigkeitswerte mit der Bakterienzahl vergleichen, können wir feststellen, daß die Zahl der Bakterien auf dem nördlichen und südlichen Hang in den Bodenschichten mit niedrigerem Bindigkeitsgrad höher ist. Dieser Zusammenhang kann auf dem östlichen und westlichen Hang nicht immer nachgewiesen werden, was darauf hinweist, daß hier in der Entwicklung der Bakterienpopulation auch andere Eigenschaften eine Rolle spielen. So wie wir uns auch früher schon damit beschäftigt haben, wird die bakterielle Tätigkeit durch den Feuchtigkeitszustand des Bodens wesentlich beeinflußt (auch auf den Tafeln stehen die Feuchtigkeitswerte). So lange auf dem nördlichen Hang die Höheren Tagestemperaturen (*I. Bárány*, 1967., 1983.) die Herausbildung eines niedrigeren Feuchtigkeitsniveaus verursachen, so lange ermöglichen auf dem südlichen Hang niedrigere Tagestemperaturen die Erhaltung eines höheren Feuchigkeitsniveaus. Im letzteren Fall sichert der Boden günstigere Voraussetzungen für die bakterielle Tätigkeit. In seinem Charakter ist der Temperaturverlauf auf beiden Hängen ähnlich, nur auf dem südlichen Hang ist Tagsüber die Temperatur wesentlich geringer. Daneben ist es auch günstig, daß auf dem südlichen Hang (nördliche Exposition) die Amplitude der Tagestemperatur klein ist, welche auf dem nördlichen Hang auch das dreifache betrage kann. Die Bakterienzahl weist mit den pH—Werten des Bodens auch auf den N—S—Querschnitt hin. Im O—W—Querschnitt ist dieser Zusammenhang schon koplizierter, der Temperaturverlauf weicht zeitlich von dem auf dem nördlichen und südlichen Hang erfahrenen ab. Die Tagesamplitude ist kleiner als auf dem nördlichen Hang, aber größer als auf dem südlichen Hang. In 5 cm Bodentiefe ist die bakterielle Tätigkeit wesentlich intensiver als in den tieferen Schichten, da die obere Bodenschicht maßgebend ist bei der Herausbildung der Zusammensetzung der Bodensäuerung noch weiter ab.

Zwischen der Menge der Kationen und Anionen finden wir vorwiegend auch auf dem nördlichen und südlichen Hang eine Korrelationsverbindung, die auch in den Dolinen von Aggtelek auf ähnlicher Weise zu beobachten ist.

Zusammenfassend können wir feststellen, daß auf unseren beiden wertvollsten Karstgebieten in dem Bükkgebirge und im Gebirge von Aggtelek die untersuchten Dolinenböden sich in Richtung der Bodensäuerung entwickeln. Die Dolinen von Bükk stehen unter Naturschutz, in den Dolinen von Aggtelek und ihrer Umgebong befindet sich freie Tierhaltung. Das Maß der Bodesäuerung ist im Falle der unter landwirtschlaftlicher Produktion stehenden Dolinen stärker als in den unberührten Gebieten. Gleichzeitig können wir feststellen, daß bei den Karstböden ohne menschliche Einwirkung auch ein Tendenz der Säuerung zu beobachten ist, welche auf die Wirkung des säuerlichen Absetzen zurückzuführen ist. In den Dolinen von Bükk hat sich die bakterielle Tätigkeit verhältnismäßig zu den früheren Jahren verringert, die sich in tieferen Bodensäuerung — entsprechend der Erhöhung der Bodensäuerung — noch weiter verringert.

Angesichts der Entwicklung der Oberflächenkarstform ist die Berücksichtigung der oben genannten Eigenschaften sehr wichtig.

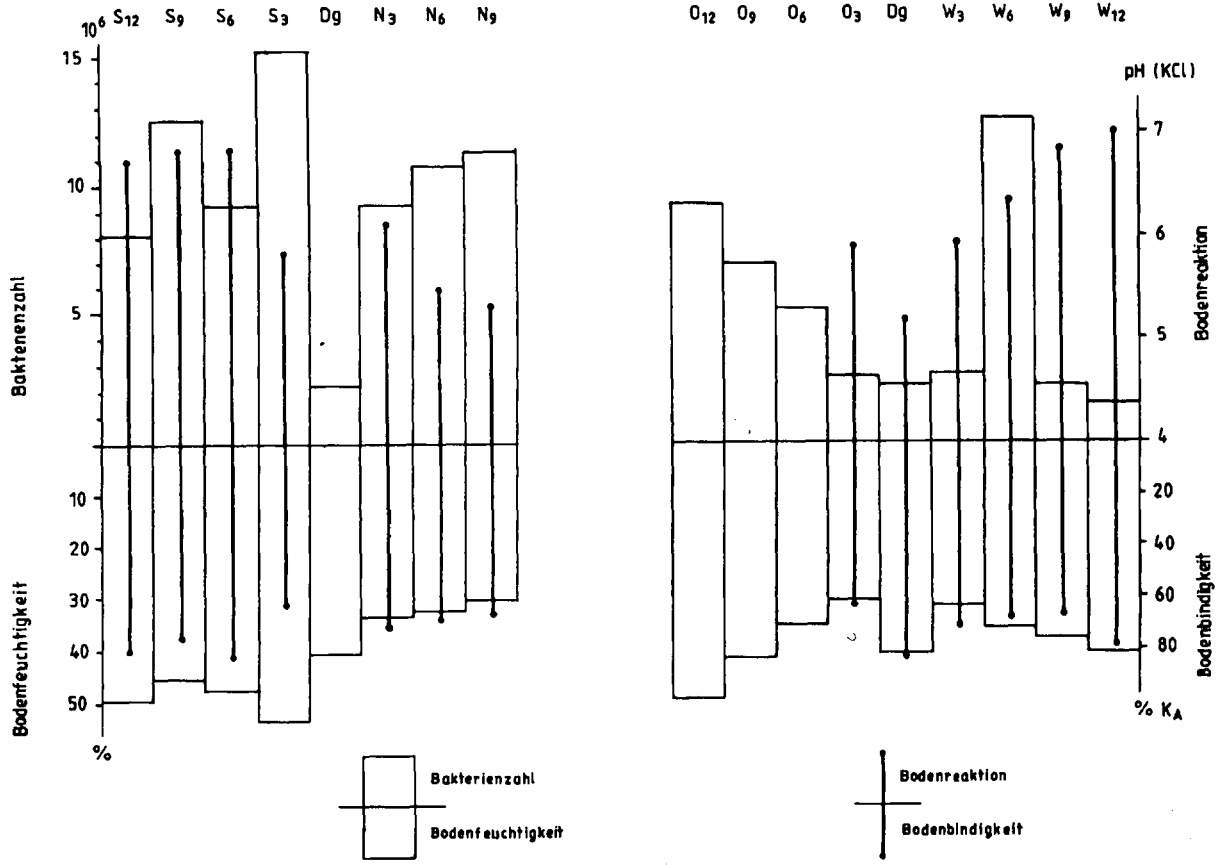

Abb. 6. Die Bakterienzahl und die Bodenfeuchtigkeit bzw. die pH—Werte (KCl) und die Bodenbindigkeit (nach Arany) auf den verschiedenen Abhängen einer Doline im Bükkgebirge in einer Tiefe von 5 cm. (Buchstabensymbole s. Abb. 1.)

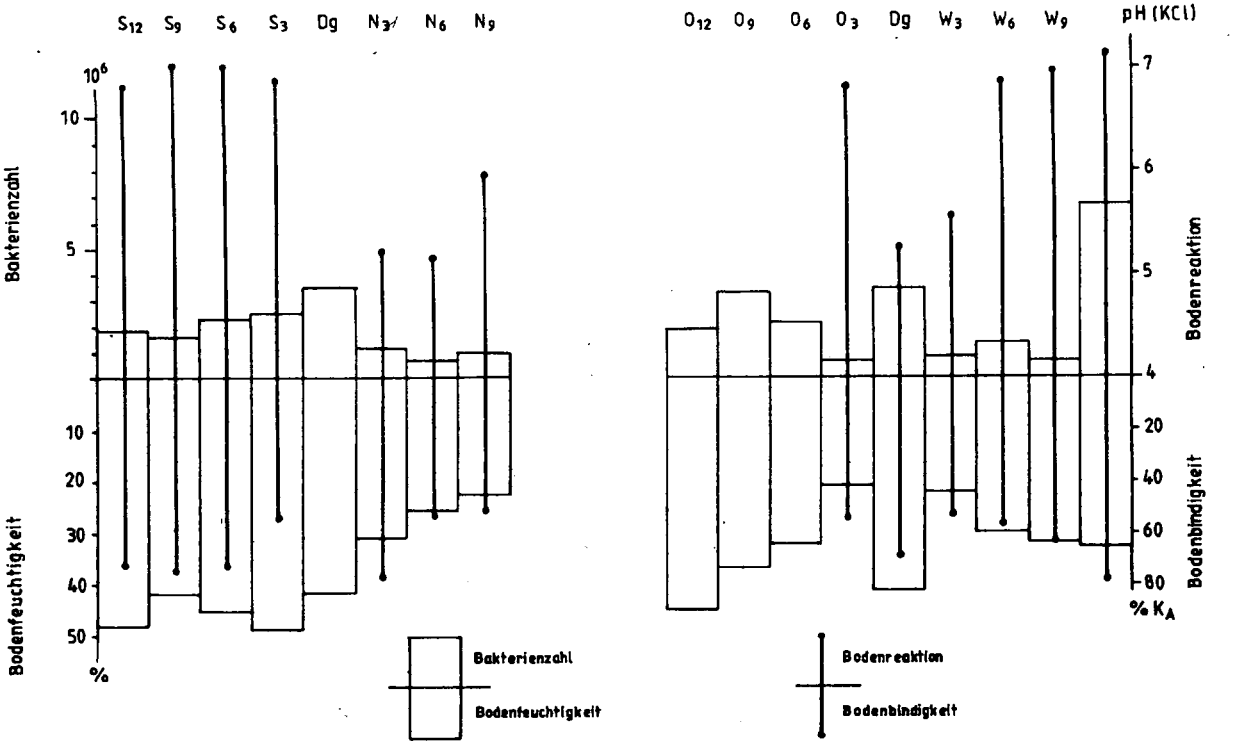

Abb. 7. Die Bakterienzahl und die Bodenfeuchtigkeit bzw. die pH—Werte (KCl) und die Bodenbindigkeit (nach Arany) auf den verschiedenen Abhängen einer Doline im Bükkgebirge.

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GEOGRAPHICAL INFORMATION SYSTEM IN HUNGARY

Á. KERTÉSZ — G. MEZŐSI

Department of Physical Geography
A. József University, Szeged, 6722, Hungary

All over the world there is increasing interest and need to evaluate and direct environmental system because of the deterioration of natural ecological system. It is all the more important to apply fast and effective means when planning the environment.

Anyone who is dealing with ecological questions realizes that is becoming overly difficult to provide exact information both theoretically and methodologically as well about the environment, as the latter is becoming more and more complex. It is, therefore, necessary to have a wider spectrum of the relationship of ecological system, the complex mechanisms and it is also important to examine the effectivity of ecological units, and evaluate the stability of different system. For all this, naturally, new methods are required. Let us just think of the fact that is we use more maps and more survey photography, we will be unable to compare anything manually. We do hope that more and more people will realize that these questions must be examined on the basis of geography. We have to see that the validity and credibility of our studies depend on the answer given to these questions.

From the beginning of the 1970's it has become possible to measure up oecological system, to connect information gained from maps and charts, and to store data and generate new ones on the basis of a new synoptic view. All this has become possible because of the application of computer system. We have created expedient informative system which enable us to carry out environmental surveys more effectively, more exactly, and more economically. It is necessary to work out computer methods and adapt them in order informative system, and that is why it has become a way of measuring up a country's scientific level by measuring up to what extent it is provided by informative system.

Geographical information system (GIS)

In Hungary GIS is interpreted in a wider and narrower sense. In the wider sense GIS is interpreted as a general informative system, which enters, stores, and evaluates data on the basis of a well defined spatial correlation. In this sense GIS is a synonym concept of spatial informative systems. By GIS we mean a total system of environmental factors which makes it possible to enter, transform, store, and process data in order to get hold of new information, which we may utilize in geography and in practice as well.

Computerized GIS includes the data bank, and the methods needed to process, store, and further data. On the basis of this, there are three distinct components of GIS:

— data system (entering, transforming and storing data)
— processing system (data processing)
—. control system (credibility, simulation models)

Data system

The most important point of any branch, or integrated environmental research is collecting and processing data. We have to process and transform data for our research to get hold of information. The data bank is not more than a storehouse of data, which have no meaning without further processing. When compiling the data bank we have to clarify in what system we will use our data (e.g.: at range taking we have to apply for placing and processing 10^6 data/sec).

Nowadays several institutions and organs have data systems in Hungary. This should mean that it has become easier to compile a data basis, however, this means several unanswered questions as well. For instance the data may accrue from several sources- from range-taking, from maps, and from field. These data may significantly differ in their informative value and credibility. It is difficult to apply them, as some of them are stored in raster (e.g.: remote sensing data) and some of them in vector from. Price is also an important question in connection with data. Data systems are becoming more and more expensive because the price includes the processing technology in an indirect way.

Processing System

GIS includes those means which are important and applicable to get hold of information, and in the case of computer systems algorithms and basic methods belong to this structure.

In connection with informative geographical systems together with capacity, credibility, and rentability, compatibility is also an important requirement. The complexity, bulk and price of the environmental data to be used make us apply the best possible means and methods which enable us to advise experts in the most understandable way.

Because of the special progress of environmental and spatial geography the concept and logical models are lagging behind.

In a simplified way one can distinguish two types of data entering and processing systems used in Hungarian field and environment research. One is branch data collecting and making topic maps, then by superimposing them the desired result may be achieved- the other one is collecting data-integrated data bases-synthesis. Both approaches are strongly based on classification and generalization in order to

reduce the large quantity of data. These methods have the great disadvantage that their success and mistakes greatly depend on the applied classification methods (as the original data are substituted by class or type characterizations). Problem solving with the help of GIS seems to be a great step ahead as for quality, as the data will not lose their original details and the possibility to use them for alternate classification and typifying will remain.

Control system

Good result may not be expected without proper data. However, data are not the only source of mistakes in GIS as these multiply because of the processing methods and models.

GIS in Hungary

Geographical information systems in Hungary well reflect to what extent we are behind Western European countries in technology. In Western European countries the main task is to work effectively the existing technological means and methods, on the other hand, in Hungary we are doing experiments which make problem solving possible with a GIS background, and to adapt the internationally used processes. To adapt and use GIS on a wider scale is especially difficult because recently made computer programs to store and analyse geographical data are not widely spread. We do not know well enough data processing methods yet, and many people still doubt their effectivity. The only exception to this is the informative systems used in simple computer cartography and digit modelling.

A. There are 7 or 8 significant and functioning data banks in Hungary, and there are experiments done to improve them into information systems. The following systems will be adapted in a short time:

Soil Information System (MTA TAKI)
Agrochemical Information and Directing System (MÉM NAK)
Surveying and Map Data Bank (FÖMI)
Aereal Statistical Information System (VÁTI, KSH)
Data is being fed into the following systems:
Recreational Information System (VÁTI)
Environment Protection Information System (OKTH)
Recultivating Information System (KFH)

There are three problems in connection with these systems:

— It is very important to make use of these data bases in the most compatible way. Effectivity is harmed if data bases are based on a different system of relationships. This problem will be solved by the unified identification system, called geocode. This is to be used according to a Ministerial decree.
— Accessibility to the data is very problematic. The legal,financial and technical conditions are still not clarified. That is why a large number of data are not accessible yet.
— At the moment software and experts are not available, although these would be vital to produce complex data.

B. Creating the Complex Environmental Informative System is under way in the Geographical Research Institute of the Hungarian Academy of Sciences on the basis of the following principles:

In our opinion only one logic data basis should exist for each mass of data. Several copies mean a lot of extra work and more source of error. This of course does not mean that we should store every geological datum in one data basis, but it means that is would only exist as a logical unit. (Environmental Informative System), but in most cases it would consist of separate units.

In our case these would fit the already existing informative system described above. The concerned authorities are responsible for the accessibility and functioning of these.

— These data banks will be connected to the Unified Data Recording System, which is to organize entering and treating data.
— We want to assure that the system works and many data are available by connecting it to the already existing and functioning ARC/INFO, MAP, ARIADNE informative system, and by applying their principles.
— Considering our hardware facilities we feel that greater emphasis must be placed on larger, existing memories than on rough calculating capacity.

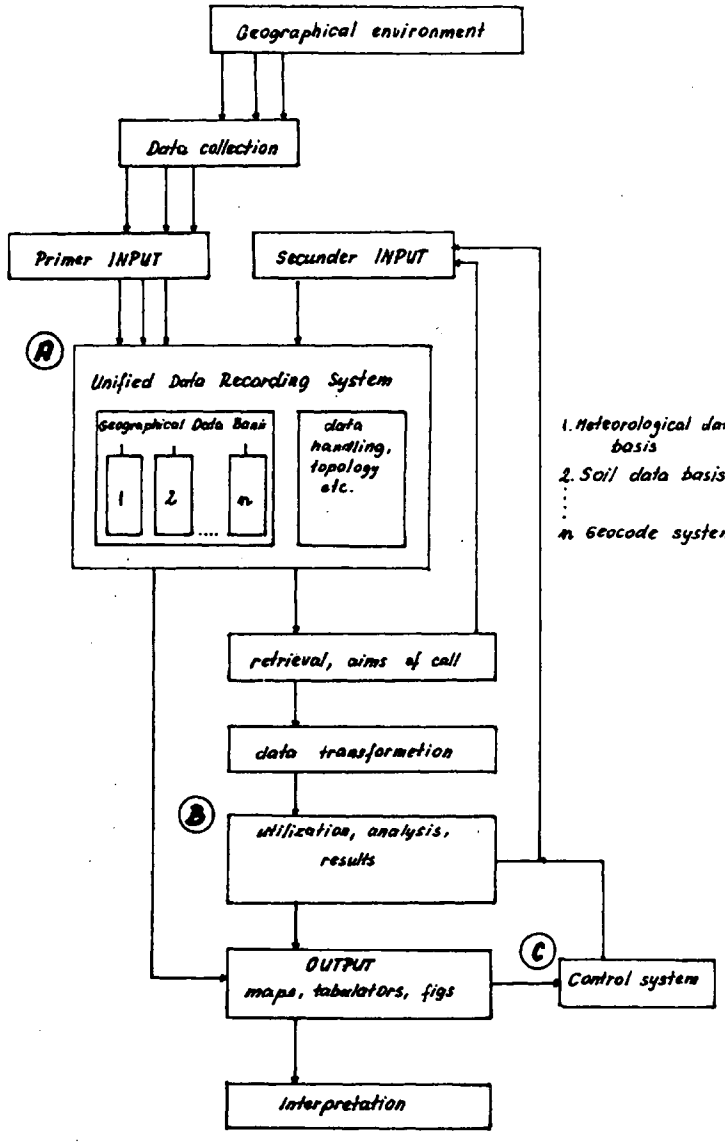

Fig. 1. The structure of the Environmental Information System

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POSSIBILITIES AND LIMITS OF MICROCOMPUTER USING IN GEOGRAPHICAL EXAMINATIONS

I. BALOGH — Á. KERTÉSZ — G. MEZŐSI

Department of Physical Geography
A. József University, Szeged, 6722, Hungary

In the decade of 1980 the awaiting questions of geographical sciences need undoubtedly more and more complex exact and quick answers. Some research field e.g. interpretation and processing of satellite photos, versatile qualifying of the environment, thematical mapping haven't already done without automatic data processing and substantial advance could hoped by its use sometimes. Therefore it would be advantageous to survey those hardware and software possibilities (and limits) of automatic data processing which considering our technical and scientific background we can rely on. We would like to loosen up the presentday existing reserve of the geographers from the computer aided storage analysis and visualization of geographical data. There are many sceptical opinions about their usefulness, too. Desirable change of attitude can expected only if the geographical problem solving with automatic data processing wouldn't be the privilege of the „qualified ones" but everyday practice. The reserving could explained by the fact that most of the available computers with high capacity were available with difficulties, their use were extremely expensive and complicated and most of the problems hadn't required such a high capacity at that. At the same time first ones of microcomputers had been coming out since 1970-71 had moderate inner memory and peripheries, slow data processing that significantly limited their use.

To reduce these problems those kind of microcomputer systems were put into circulation which had much considerable inner and external memory, so large sum of data storage and data processing were made possible. These systems are associated with high resolution colour displays, printers etc. Some of the large years the developing of the hardware was so dynamical we can observe generations of microcomputers (table 1.).

The computer itself isn't enough for the effective problem solving, it needs proper software. Regrettably software developing is slow, labour-consuming process and became neither easier nor faster when new machines had appeared. The creation of a new program takes rather long time. That makes the coefficient of the hardware usefulness more and more smaller. That's why software developments were often made by the use it „obsolete" first and second generation computers.

Table 1.

EXAMPLES OF FIRST FOUR GENERATION OF MC
(after *R. Barr* 1985)

	Examples	Dominant processor
1977 First gen. 8 bit	Commodore 64 Apple II. BBC Micro	6502
1981 Second gen.	Epson Q X 10 RML 380 Z Superbrain	Z 80
1981 Third gen. 8/16 bit	IBM PC Sirius 1 ACT	8088
1983 Fourth gen. 16/32 bit	Apple Lisa Sage	68000

Hardware and software environment of the main user's fields

General inland use of computers made their use wider spreading in geographical fields too. In the course of its using the computer gradually changed the way of information handling, it became interactive transferring and processing device.

Data processing

The right ways of the data processing, and storage are very important, because that makes their later or rather repeated utilization. The way of data storage is playing important role in the speed of the processing and how many times can we examine a data sequence with difference programs without the changing of the structure of the data file. Therefore it is practical to develop different programs with standard data processing so data files could make real data banks for different users, too.

Nowadays several program packet were developed for the data file processing. These programs are generally written in BASIC are available for almost all the circulated machines. Unfortunately sometimes the programs written for same

computer have needed different kind of data storage, making their use slightly difficult. Using these packages we can compare values, analyse them make diagrams, tables, solve different kinds of problems of mathematical statistic. Their use doesn't require profound preliminary training in program-making, it supposed only the knowledge of handling the computer and its peripherial units. The common hardware configuration for these programs are the next:

— computer
— external memory unit (tape or disk)
— television screen
— printer

There are well prepared programs for the data management of geography, climatology and environment qualification

Modelling of systems

The modelling of various kind of difficulties of geographical systems had been trying from the midst of the sixties, but models which were build up on exact mathematical base had been used since the seventies. Because of the many alternative possibilities of the adequate methods for the more and more complicated, multifactorial economyprognostical, ecological problems presumed and required the use of computers. These methods made possible the recognition of the inner structure of the multifactorial connections. First ones of these models had run on high capacity computers, but nowadays already have enough capacity for the examinations. Program-making require thorough geographical and mathematical knowledge and programming experience in most cases by the collective efforts of three men. The schoosing of programming language can cause problems for the adaptations of the ready programs. In the case of the BASIC the main problem is the inner limits of the language, not the difficulties of its use. So it is not recommended. From the group of the old, well known programming languages the FORTRAN's use is advantageous. Amongst the new languages the extremely quickly spreading PASCAL's use seems to be the best.

For the processing the next configuration is necessary:

— third or fourthgenerational computer
— display
— external memory (to read in the program and to store result)
— printer.

Thematical mapping

In the middle of the seventeens microcomputers appeared in the field of the cartographical works. Amongst the first ones was the Apple II microcomputer which were used in mapping because it have high resolution graphics. It guarantied

the addressing of 280x190 spots independently from each other. Although that is rather rough for serious cartographical works but its low price made it widespreading. So the first attempts of mapmaking by computer have done by that type of machine, that resulted many cartographical software for the Apple II. But the results achieved that way are far from the ideal, so the computer aided cartography still remains an open question.

The manual producing of a map with high information content is the result of long and precise work. The use of the computer requires the digitalization of spatial informations and the proper capacity of inner and external memories. The information content and the detailing of the computer-made is depend on the ability of the digitalizing equipment, but unfortunately those upper limits are rather low. High sensitivity digitalizers are very rare and expensive. That's why it is very important to examine less expensive digitalizing systems with microcomputer in which situation may be inadequate or whether a quick approaching result is adequate or not. In the majority of the cases the latter often happens but the possibilities of microcomputer systems prove to sufficient for map presentation rather than analysing it in details. Other problem is the limited resolution of the displays which needs other kind of approaching in the planning of the maps and symbols which can be easier comprehendable distinguishable and appearable. The presentation of map on sheats depends on the printing device and the capacity of the backing store. So we can't utilize the possibilities given by computers in every cartographical problems.

If we'd like to solve cartographical problems by the use of microcomputers, its will be soon clear the quantities of the computer are less important than the connecting peripheries'. The usefulness of the computer is mainly depends on the connecting peripheries.

The main input device of most microcomputer is the keyboard. In the event of cartographical works the input processing is closely linked to the digitalization. The ruder ways of digitalizing (by joystik or light pen moving) are gradually superseded. The higher level of cartographical works require some kind of mechanical or electric drawing table. Their disadvantage is the limited drawing area, which can cause serious problems at the digitalization of larger sheets of maps, and also their resolution and stability can cause difficulties. The future's way is the direct data input from videocamera what is available in experimental state now. That would cease the differences between the image analysis (mainly occurring at the space photographs) and the computer aided traditional methods mainly dealing with the topological characteristics of the maps.

The computerized displaying of the spatial informatics also means great problem. The high resolution graphical representation mode of the microcomputer can seems to be advantageous. But in some cases it can limited the use of the computer because of the necessity of too large memory capacity that makes impossible the applying of the required software or the changing of the pictures. These kind of limits is becoming less in the latest computers but the commercial ones often have them. The most common output devices are the colour or monocromatic displays with conceivably increased resolution lately. Nowadays the suitable standard is the

512x216 pixel or the 800x400 ones in some machine. The resolution of the colour display is less because of their price and the background memory. The state of a monocromatic pixel can be stored in one bit of the memory but is we want that pixel have 2^{nd} colour it requires n bit.

Nowadays most map made by computer have to photograph from the display or print by pointmatrix printer. The best output of the computer aided mapping is produced by plotters.

Knowing the dimensions of the programs used at the automatic mapping and the data for managing experte consider unsuitable every microcomputers which aren't connected to at last one disk unit, as backing store. The processing of the magnetic tape units are difficult and slow. Bigger or detailed maps are made partly, step by step; data which are good for the inner memory are read out from the backing store, and the necessary operations are taking. Nowadays plenty of 350 — 600 Kbyte floppy disks are available but the data for the processing a map with the scale of 1:50.000 can be stored approximately in 10 Mbyte area so the use of hard disks with larger capacity (5—20 Mbyte) also needed.

The most critical point of the utility is the software. Most of the utilizers have no programming practice and use program packages, ready to run, standard subroutine libraries and operation systems. For these reasons the software must be stable and reliable. The program have to process every permitted data certainly and can't fail even the occurring of the total absurd parameters. The software have to be documentated detailly either in separate handbook or build up informations appearing on the screen.

The used language or code have to provide quick data transmission and running and can be transferable into other type of computers. For these purpose the BASIC isn't suitable because it makes difficulties at the computer aided carrography. Because of the compilation the running of the BASIC programs are slow aren't enough effective and doesn't support the making of wellstructured long and complex programs. The missing possibilities of the different subroutines and processes makes the modular programming unnecessarily difficult.

Geographical information system (GIS)

It is doubtless that the building up and the operating of the geographical information system require the complex applying of the above mentioned process for the computerized GIS include data system and the require methods and techniques of the data processing transferring displaying and checking too. The three main problem in connection with the use of the existing and being developed GISs:

— The most compatible connection to the different databases is very important. The efficiency is very low if the databases are set up on different systems. Geocode the unified identification system based on the geodesical coordinates seems to solve that problem.

— The access of data are very problematical from the above mentioned database. The economical legal and technical conditions have cleared up insufficiently. Unfortunately there are lot of valuable data in latent, inaccessible state.
— Nowadays the necessary software instruments and experts are still missing for data informations and the production of combined data.

Our principles for the building of the Complex Environmental Information System:

— In our opinion every mass of data have to connect with only one logical data base. Multiple copies means considerable additional work and great source of errors. Of course we don't mean every geoscientific data would be stored in one database but it would be existing only as a logical unit (Enviromental Information System). Most cases it would have consisted of different physical units. These would have been the difference sectional (soil science, environment protection etc) information system which are still having been operating.
— These databanks will be connected to a Standard Dataregistration System which is for the organization of the data input, output and processing.
— The operating of the system and the possibilities of the different inquiring will be assured by connecting to the existing and working ARC/INFO, MAP, ARIADNE information systems and the applying of their principles.
— Because of our hardware possibilities we lay the stress rather the structure of the system than the counting effectively of the computers.

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RESEARCH TASKS OF THE BORDER REGIONS OF HUNGARY

GY. KRAJKÓ

Department of Economic Geography
A. József University, Szeged, 6722, Hungary

Over the past few centuries borders have not proved to be stable in many countries of the world, even country boundaries determined by physical factors, often mentioned in geopolitics, were modified.

The history of Hungary for all its interesting changes and turn has also determined the size of the country. The Treaty of Trianon after World War I readjusted the boundaries between the Biddle European states; consequently the spatial structure of economy formed during the earlier decades was destroyed and the settlements concerned found themselves in a disadvantageous situation. A number of problems rising from this historical fact are worth examining:

— The historical process had a significant impact on the forming of the spatial-structural relationships and the fortune of the settlements in the border regions. Thus logically, during the research work we have had to look to the past, into different depths according to each region. For instance, historically the Hungarian Örség region has always played a border zone therefore completely different factors influenced the settlements in this region than those found in the settlements surrounding Szeged, due to the fact that the latter was one of the largest centers in the Hungarian Plain until the end of World War I, while the former region was periphery even at that time. The city of Baja is also in a unique situation, because it had an administrative function earlier, while today it is a paracentre with a significant zone of attraction. It is obviopous therefore that an understanding of the present situation is very difficult without a historical analysis that examines the changing of the spatial structure.

— The new boundary created after World War I resulted in a peculiar situation for the people living there; the Hungarians living in the new neighbouring countries became border national minorities, while the national minorities living within Hungary became a minority living in the immediate vicinity of their mother country. On both sides the assimilation process started or continued in the circle of the national minorities, but at the same time they preserved their national identity to a significant extent. At present the national minorities on both sides play a specific role in the widening relationship with the neighbouring countries. It is advisable to run sociological research work and examine ways of thinking of the national minorities and the possibilities of intensifying the connections with the neighbouring countries. (For example: the exchange of cultural values beside just the frontier traffic and family visits, the widening of the educational possibilities, etc.)

— Knowing the historical processes helps the more precise territorial differentiation of the border zone. After World War 2 the improving economic cooperation with the neighbouring countries, the increasing exchange of goods and personal traffic, furthermore transit traffic through Hungary created a more favourable situation for many of the frontier settlements (eg. Záhony), more than in other settlements, where did not seem to change visibly. The economic radiation of some larger cities like Szeged, also contributes to the territorial differences. After World War 1 and during the decade following the Second World War in particular Szeged was in an unfavourable situation, its development stagnated, the last decade progress has come about due to the fact that our connections with Jugoslavia improved, the position of Szeged improved with respect to transit traffic which increased to a significant extent. Therefore it is reasonable to accentuate Szeged and its surroundings especially its role in the border zone.

Each of the territorial differences require different methods of research work. Accordingly the cooperation with the countries involved, varies by different sections of the border.

To set the exact limits or size of the border region is a problem. It cannot be said generally that the border zone is a 30-35 km wide strip of land because it is narrower at some places and wider at some others. It seems to be more advisable to examine the available data for a much wider zone or for the entire country, and then on the basis of these try to determine the border region more precisely.

It must be added that the essential task of the research work is not to determine the exact extension of the boundary region, in fact it cannot be precise because of the transitional areas, but to study the settlements in this zone, to explore the possibilities of development, and to find ways for better cooperation with the neighbouring countries in the interest of better exploiting the local resources.

The tasks of research

The study of border regions is not a new field; in relation to other geographical research work a number of important statements and conclusions have already been made which are worth collecting from the point of view of our research theme also. The examining of the boundary regions (eg. Szabolcs county, Northern-Hungary or in the Örség region, etc.) have yielded many significant scientific results.

An overall monographical work for the whole country cannot be expected in this theme because the main problems we have to deal with, vary within regions to a great extent.

The different research groups should come to a common agreement on only the most important aspects of what shall be practically elaborated, which can later, in practice, be worked but to different depths. In our opinion the research work should involve the following scope of problems (the research of the Danube section between Hungary and Czechoslovakia obviously diverts from this because the mutual investment induces unique problems, like environmental protection.)

a) We do not wish to study the settlements in monographies. Instead of this we give priority to the detailed examination of the advantages and disadvantages deriving from the location of each settlement; we also have to examine at length the local physical and social potentials, which, by their exploitation, the living conditions of the population can be improved. It means that we have to work out each factor of the spatial structure of economy, and to determine the strength of the relationships so that we can see the contradictions and distortions formed here which became acute at some places and caused regional crisis.

Analysing the spatial structure of economy we have to go back to the period before World War 1, because a number of the processes started as a consequence of the readjustment of the borders by the Treaty of Trianon. Consequently the interrelationship system modified to a great extent.

b) The natural resource factors should be evaluated from the point of view of development. We have to take into account the relationship with the natural landscape, the geographical, agrometeorological conditions, the fertility of soil and the utilisation capability of the surface and subsoil waters. The physical geographical potential also involves the rational management of the mineral resources.

In a word not the monographical factors are necessary, but the economic evaluation of them. In this way we provide a stable starting basis for the arrangement of the spatial structure of economy and for the revelation of the contradictions experienced here. (For instance, in some places inside of all the favourable geographical potential the ability of the settlement to hold on to population is very weak, the composition of population according to age is distorted etc., and the settlement did not develop either.

In this case we have to look for the solution somewhere else; the traffic geographical situation, maybe unfavourable for the settlement or subjective factors may cause stagnation.

In the boundary region the methodological, practical and legal questions related to environmental protection arise in a peculiar way. The problem of water-, air-, and soil etc., pollution appear with different emphasis at the various border sections.

These problems can only be examined together with the cooperation of the research workers of the countries involved.

c) In the boundary region agriculture is the most general element in the production sphere of the spatial structure of economy. Here beyond the traditional evaluation there are some special regional problems too. We have to evaluate the technical level of the agricultural activity further that of how the cultivation of land complies with the natural resources and markit conditions. We also have to examine the labour force supply, how efficient are the secondary activities and what sort of cooperational possibilities with the neighbouring countries can be found in the sphere of trade. In summary it is advisable to determine the level if agricultural development and the regional differences of it by means of a complex index.

d) In the border region agriculture is increasingly supplemented with industrial activities. In some places, especially in the towns it provides the most important

occupation of the population. In rural areas we have to evaluate the role of industry as a power in holding on to the population besides just its efficiency, structure and nature. Then as with agriculture, the level of industrial development is to be determined. During the research work we have to try to determine the main trend of development and to work out the cooperational possibilities with the neighbouring countries.

e) Examining the infrastructure of the settlements, two fields seem to be worth while to be examined more thoroughly: one of them is that, on what level can the commercial, public utilities, educational-cultural, health etc. supply of the population be solved from the point of view of efficiency and that what kind of influence can be expected on the ability of the settlements to hold on to population. The other field is the geographical situation of the settlements in respect to transportation and the impacts deriving from it on the agricultural and industrial activities. Experience shows that traffic conditions are mostly unfavourable and many disadvantages arise in the transport of agricultural products, also this hinders the more mobile, better use of the labour fource. In both fields contradictions have a direct influence upon the population and contribute to their migration to a great extent, while at the same time the situation could be improved at a relatively low cost. That is the efficiency of the productive branches can be increased and this way the ability of the settlements to hold on to the population can also be improved. In the research work of the infrastructural supply system of the settlements it is also necessary to determine the complex level of development and the precise regional differences deriving from it.

In choosing the system of indices it is very important that the level of agricultural, industrial and infrastructural development should be comparable because it is essential for the further analysis of the interrelationship between the three elements of the spatial structure of economy. Experience shows that there are significant contradictions between the above mentioned three factors in all the regions of the country, but it especially refers to the border regions of the country, where, expert the border crossings, mostly adverse supply circumstances and very disadvantageous traffic geographical situation are characteristic.

Consequently the economic activity, the income of the population and the development of the settlements are not satisfactory either.

f) During the examination those characteristic features are to be stressed from among the most important ones of the population, which are of determining nature. All the indices should be grouped so that each process can be followed clearly from the period before World War I until now. The change in population, the trend of the important demographical indices, the process of restratification and the mobility of the inhabitants are such elements of population geography which cannot be easily explained without an adequate social and economic background.

So as I have already mentioned all the elements of the spatial structure of economy have to be described historically too.

In the description of the population the central place is taken by the migration process. It cannot be separated from the changes taken place in the country. The majority of the settlements of the border region were in a rather disadvantageous

situation between the two world wars, but only a small proportion of the population left, for the simple reason that there were no such centres in other regions of the country which were able to accept them.

After World War 2 especially the "energy-axis" and the industry of Budapest developed dynamically as the first wave of socialist industrialization. A significant part if the labour force necessary for this came from the countryside. Consequently the out-migration from the weakly industrialized areas and the border regions increased. The migration intensified by the socialist reorganization of agriculture, which released great masses of the work force. The development of the secondary activities at the co-operatives together with the development of industry in the villages, the regions mentioned could employ more and more workers. At the same time, in the industrially developed areas, the intensive phase of the development started, consequently their demand for new workers decreased. As a result of these two nationwide processes the migration of the population considerably decreased and a number of settlements could stabilize their situation. Unfortunately the situation in the economically disadvantageous, less developed regions with unfavourable natural potentials — a significant part of the border region can be listed here — hardly improved.

An explanation of this is that as a result of the out-migration, in respect to villages, lasting for decades, the composition of the population has become very unfavourable: the proportion of the old is very high, while that of the skilled workers is low (those who trained themselves did not return to their home towns), the reproducing process of the population has been deformed to a great extent, the birth rate has decreased while the death rate is unnecessarily high.

In certain areas the developing of industry alone is not enough to hold on to the population. That is another question whether industry can be developed with the required efficiency evrywhere.

Consequently in certain settlements a bigger or smaller concentration of industrial activity and population has inevitably formed. The conditions of their formation require a detailed analysis. The analysis of the effect mechanism of all the factors motivating the migration is also necessary, because it helps to determine the future possibilities of each concrete area.

The population geographical investigation can help the evaluation of the local socioeconomic potentials and its better usage. In the next few decades the significance of the local potentials will be upgraded in the economic development. Besides the natural resources the most important local potential is labour force. Therefore it is necessary to deal with the flow of the work force, its professional composition, the possibilities of its vocational training and the level of qualifications in detail.

Experience shows that during the intensive economic development, mainly the level of qualifications determines the prospects of economic growth. It can be often heard that the main reason of the backwardness of the developing countries is the lack of skilled workers. Unfortunately a similar situation developed in the rural settlements close to the country boundary, because the majority of the skilled workers left. To record the work force it is necessary to make a balance of labour

force for each settlement or for settlement groups, which can serve as a starting point to the precise evaluation of the future prospects.

g) The analysis of the development of the settlement network and settlement systems rely on the examination of the above listed elements of the spatial structure of economy.

The characteristic analysis, classification and system in the geographical monographs are considerably modified here and as I have already mentioned, there is a shifting of stress.

Practically the investigation of the interrelationship between industry, agriculture, population and the infrastructural degree of supply helps the population geographical conclusions. It is completely in accordance with the recent efforts in this scientific branch that settlement policy has to rely in the complete knowledge of the spatial structure of economy. Within the border region it is advisable to examine the role of the rural settlements and the particular situation of the towns. The relationships among settlements, the attraction zones give an important element of the development of settlemet groups and this phenomenon obviously is not confined exclusively to the boundary region. The settlements of this region organically are joined to other parts of the country, either as the attraction zone of a centre, or like in the case of Szeged the majority of the settlements closely attracted by and dependent on Szeged do not belong to the area examined.

We have to deal with some special towns separately. For example in the case of Szeged, its being in the border region has been very important from the point of view of its history, development, as well as its relation system and it also has a determining role in the economic and cultural co-operation with Jugoslavia.

Methodological questions of the research

The elaboration of the topic is a complex task and requires the collaboration of the representatives of many other scientific branches besides geography. The social movements, the composition of the national minorities and the significant differences in the living conditions, living standards of the population makes the overall sociological analysis necessary. These cannot be substituted by social geographical studies, but awaited results of the research, which naturally the geographers have to do, are indispensable to the synthesis. History with its own method of research can usefully contribute to the proper conclusions. It is not a new solution from the point of view of geography, because economic geography has always relied on the results of history. A relatively new task is the co-operation with the lawyers, who are ready to collect the international legal references of environmental pollution , small border traffic, the mutual flow or work force etc., concerning the border region and also help to solve the problems arising in this field.

Beside the scientific branches mentioned above, the help of the professionals of water management is worth mentioning. Water management is important not only along the Danube or other rivers like the Ipoly and the Drava, but also significant

along sections of the boundary, where the co-operation of the neighbouring countries is indispensible to solve problems of water management, for example the Körös rivers area, Northern Hungary, the Jugoslavian border between the Danube and the Tisza, which is not very rich in surface water. The spatial structure of economy is torn by the country boundary from many points of view, but does not stop the influences.

The close co-operation with the research workers of the neighbouring countries is indispensibly necessary when studying the border region. Practice has forerun this co-operation. A great number of examples can be listed, which are efficient and advantageous for both partners. For example: in Northern Hungary the exchange of agricultural equipments help harvesting; co-operational relationship has developed between Bács-Kiskun country and Vajdaság (Jugoslavia) for processing agricultural products (sugar beet, fruit, grape).

In many places co-operational agreements have been made for sensible water management, for the mutual task of environmental protection and for the exploitation of mineral resources (hydrocarbons, coal). Recently the number of the mutual cultural programmes in the circle of the minorities has been increasing.

Between the Hungarian institutes dealing with this theme and the institutes of the neighbouring countries being in the geographical vicinity, an advantageous scientific collaboration has developed. For example, the Department of Geography at the József Attila University of Szeged cooperates with the Department of Geography at the University of Novi Sad (Jugoslavia); the geographers of the Teachers Training College of Nyíregyháza collaborates with the geographers of the University of Ungvár (USSR); the scientists in Pécs work together with the geographers of Zagreb (Jugoslavia); the Teachers' Training College of Szombathely cooperates with the University of Graz (Austria), etc.

So almost evrywhere along the Hungarian boundary, except the eastern border, we have co-operation with the neighbouring countries in this theme.

Of course not each institute in the neighbouring countries is interested in a complex study of the settlements in the border region, consequently it is advisable to group the mutual investigations around such questions, which fit both partners' research work and is linked closely with the elaboration of our theme.

These fields can be the following:

–The social and economic importance of small border traffic,

—co-operation possibilities in industry and agriculture, and in the better use of the work force,

—co-operation in the development of traffic and tourism

—the evaluation of other factors that help the development of settlements,

—the investigation of mutual interests in the exploitation of natural resources and water management (from the point of view of environmental protection).

The well advanced scientific research work requires the organization of a symposium where the scientists of the neighbouring countries involved could exchange their results with their Hungarian colleagues.

Even at the beginning of the research work it is advisable to know where to make use of the scientific results, how to fit them into the regional development plans. The boundary region comprises a considerable part of the territory of Hungary. 14 counties out of 19 are involved to a lesser or greater extent, therefore they are also interested in making use of the scientific results. All counties have a middle and long term settlement and regional development plan and these obviously include the boundary region too. Though these do not include the possibility of co-operation with the countries involved, nor is the evaluation of the potentials and the particular situation of the settlements belonging to the border region satisfactory.

In this way with the elaboration of our theme, the regional and settlement development plans of the counties involved can be extended and completed. Therefore the research work in this theme contributes to both the definition of the settlement policy and the development of the methodological and theoretical questions in connection with geography.

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THE MAIN CHARACTERISTICS OF THE DEVELOPMENT OF THE FOOD INDUSTRY AND THE CHANGE OF ITS REGIONAL DISTRIBUTION

JOLÁN ABONYI-PALOTÁS

Department of Economic Geography
A. József University, Szeged, 6722, Hungary

The Hungarian food industry has gone through big changes since the Second World War. The number of food industrial workers has increased from 120,000 to almost 200,000. Between 1960 and 1985 the gross value of the food industrial fixed assets increased fivefold. Now the fixed asset stock of meat industry alone is almost the same as was that of the whole food industry 25 years ago, and the gross production value of the socialist food industry approximates to 230 billion forints.

Certain food processing activities (such as production of alimentary pastes, baking, preservation, poultry processing, and manufacture of dairy products), which were previously done mainly in households, have developed into the branches of socialist food industry or become the subsidiary activities of agricultural cooperatives. The scale of food industrial products has dynamically been extended and a variety of foods meeting modern nutritional requirements have come into prominence. The stages of processing have become more compound. The domestic food consumption and the volume of exports have increased simultaneously, and the territorial distribution of food industrial productive forces has been rationalized.

After World War II the regional distribution of food industry, similarly to industry itself, was greatly disproportional. However, it should have expectedly been more proportional because of the favourable settling conditions, in comparison with light and heavy industry, especially in the raw material intensive branches. Practically almost half of the food industrial production was due to Budapest, while in the Great Plain and the Northwestern Plain, which were predominant in agricultural production, food production constituted only a small proportion of the processing industry. Food industries working out of Budapest were concentrated in the largest country towns. The regional distribution of food industry was fairly different from the regional structure of both the agricultural products to be processed and the population, the basis of the consumer market.

Substantial changes in the regional structure of food industry took place quite slowly, since the industrialization after World War II was achieved in the branches of industry to a different degree so that the annual growth rate of food industry remained below the industrial average.

The differences of growth rate in the branches of industry and the change in the distribution of the gross production value are well indicated in Table 1.

Table 1.

THE ANNUAL GROWTH RATE OF GROSS PRODUCTION VALUE BETWEEN 1950 AND 1972

Branch of industry	Percent annual growth between 1950 and 1972	Distribution of annual growth 1950	1972
Mining altogether	5.3	8.1	4.4
Electric energy industry	9.4	2.7	3.5
Metallurgy	7.6	11.6	10.4
Chemical industry	14.3	3.4	11.4
Construction industry	10.5	16.3	26.4
Building material industry	8.2	3.3	3.3
Light industry	7.4	19.5	16.9
Food industry	*7.0*	*25.9*	*20.5*
Other industries	22.4	0.0	2.3
Private small-scale industry	—	9.2	0.9
	8.4	100.0	100.0

From the data of Table 1, on the basis of the above division, it can be seen that between 1950 and 1972 food industry was next to the last in order by its 7 per cent growth. It is obvious that the considerably low growth rate of food industry, in comparison with other branches, led to a significant (about 5.4 per cent) decrease in its share of industrial production.

After World War II the development of industry was uniquely intensive in the history of the Hungarian economy. As a result of this rapid industrialization the role of industry became more decisive in national economy. Correspondingly, there were big changes also in the sectorial distribution of employees. While in 1950 the ratio of industrial workers was 19 per cent and that of agricultural workers was 52 per cent, by 1973 the former increased to 35.5 per cent and the latter decreased to 28 per cent.

This dynamic development of industry was followed by substantial structural changes, too. In the course of socialist industrialization heavy industry was principally developed and the previously traditional and dominating food industry lost its predominance. (Between 1950 and 1965 the share of food industry in the total gross industrial production decreased on average by 1% each year.)

In spite of its low growth rate, in comparison with the whole of industry, food industry was capable of processing an increasing proportion of agricultural products. (It should be mentioned here that the development of agriculture was

M. Timár: Gazdaságunk szerkezete, fejlesztési politikánk (The Structure of Hungarian Economy and Development Policy). Közgazdasági Szemle. Oct., 1973. p. 1129.

much slower). Consequently, the processing of the export products of food economy became more advantageous.

The development of food industry was achieved by territorial differentiation, thus its regional structure also changed.

In different periods and regions the share of food industry in the industrial investments was different. In a decreasing order counties Hajdu-Bihar, Békés, Bács-Kiskun, Somogy, and Szabolcs-Szatmár took the lead the share of each in industry exceeded 20%, while that of counties Komárom, Nógrád and Veszprém was below 5%. In general, in counties having more developed heavy industry the ratio of food industrial investments was below 10%. Besides the above mentioned Komárom, Nógrád and Veszprém, counties Baranya and Borsod-Abauj-Zemplén also belong to this group.

While between 1955 and 1973 the share of food industry in the total industrial investments was 10.7 per cent, between 1974 and 1977 this ratio increased to 14.3 per cent. In the latter period the increase in the ratio of food industrial investments usually took place to the disadvantage of heavy industry. The distribution of the total industrial investments among the major branches of industry was as follows (per cent):

Branch of industry	1955—1973	1974—1977	1955—1977
Heavy industry	81.0	75.8	79.7
Light industry	8.3	9.9	8.7
Food industry	10.7	14.3	11.6
Industry altogether	100.0	100.0	100.0

Examining the distribution of the absolute values of food industrial investments among the counties, there can be found big differences between the maximum and minimum values. The territorial comparison was made by the determination of the ratios between the counties having the greatest and the smallest share, respectively, in the current priced food industrial investments. The ratios are as follows.

From the data of Table 2 it may be established that the maximum values of investments were mostly obtained for counties Bács-Kiskun, Borsod-Abauj-Zemplén, Békés, and Hajdu-Bihar. The minimum value in the period examined was obtained, expect two cases, for Nógrád. The ratios show a big deviation. While in 1977 the ratio of maximum and minimum values was 63.1, in 1959 it was only 6.1.

Considering the 1984 regional distribution of food industrial investments characteristic in today's tendency, it may be established that the capital still owns a significantly larger percentage (18.80%) of the total food industrial investments than the ratio of its employees (13.65%); in comparison, the lowland's counties with limited capacity have only by 2.2% greater share in the total investments than the

Table 2.

THE RATIOS OF THE DISTRIBUTION OF FOOD INDUSTRIAL INVESTMENTS AMONG THE COUNTIES

Year	Counties	Maximum/minimum
1955	Bács-Kiskun/Nógrád	10.3
1956	Bács-Kiskun/Csongrád	6.8
1957	Vas/Nógrád	11.5
1958	Heves/Komárom	6.8
1959	Pest/Komárom	6.1
1960	Borsod-A-Zpl/Nógrád	25.8
1961	Heves/Nógrád	26.3
1962	Békés/Nógrád	16.9
1963	Békés/Nógrád	10.2
1964	Bács-Kiskun/Nógrád	15.6
1965	Bács-Kiskun/Komárom	22.0
1966	Bács-Kiskun/Nógrád	26.5
1967	Pest/Nógrád	17.0
1968	Hajdu-Bihar/Nógrád	16.2
1969	Hajdu-Bihar/Nógrád	23.8
1970	Békés/Komárom	10.5
1971	Borsod-A-Zpl/Nógrád	26.7
1972	Borsod-A-Zpl/Nógrád	23.7
1973	Borsod-A-Zpl/Nógrád	23.2
1974	Borsod-A-Zpl/Nógrád	13.9
1975	Békés/Nógrád	6.7
1976	Hajdu-Bihar/Nógrád	28.2
1977	Hajdu-Bihar/Nógrád	63.1
1984	Hajdu-Bihar/Nógrád	9.04

ratio of their employees. Taking into consideration also the differences in the level of the technical and technological development, it should be noted that the development of the lowland's counties rich in food industrial raw materials does not promise a quick elimination of the limited sphere of capacity in their processing industry.

The territorially differentiated development of food industry led to an even more advantageous regional structure of workers. Especially the period after 1958, when rural industrialization became a major question, accelerated the decrease of the disproportional dominance of the capital, and the industrial, inclusively food industrial, development of the counties of the Great Plain, the Northwestern Plain and Southern Dunántúl.

This tendency is supported by our survey of the annual growth rate of the number of food industrial employees between 1963 and 1980.

So there can be seen an opposite tendency between the capital and the 19 counties. Table 3 shows that in the period investigated the growth rate of the number of food industrial workers was the highest in counties Szabolcs-Szatmár, Hajdu-Bihar, Békés, and Baranya and that of Nógrád, Komárom, Tolna, and Vas was the lowest.

Table 3.

THE ANNUAL GROWTH RATE OF THE NUMBER OF FOOD INDUSTRIAL EMPLOYEES BETWEEN 1963 AND 1980.

County, capital	Member
Baranya	302.69
Bács-Kiskun	218.13
Békés	308.25
Borsod-Abauj-Zemplén	279.38
Csongrád	172.69
Fejér	169.88
Győr-Sopron	318.07
Hajdu-Bihar	394.44
Heves	110.32
Komárom	65.88
Nógrád	54.81
Pest	205.50
Somogy	195.94
Szabolcs-Szatmár	412.12
Szolnok	217.25
Tolna	87.63
Vas	100.00
Veszprém	122.19
Zala	270.06
Budapest (capital)	458.57
Altogether	3539.63

Table 4 indicates the significant change that took place in the regional structure of food industrial productive forces. First of all, in Budapest the decrease of the ratio of employees to 13.65% is quite substantial, approximating to the optimum value. But taking a thorough insight into the structure of food industry, there can still be found raw material intensive branches in the capital with outsized capacity. That is the case, for instance, with milk processing industry which is characterized by an excess of capacity in relation to the milk production of the capital district, and by a limited sphere of capacity in relation to consumption. A further examination of the product structure of milk factories in Budapest demonstrates that a large number of products with a long shelf-life are produced the manufacture of which is accompanied by considerable weight loss. Thus, it would be reasonable to adjust more the milk processing capacity to the regional structure of raw material production.

The capital takes an enormous share in meat industrial capacity too, in relation to marketing.

In general, it can be pointed out that now 35.33 per cent of food industrial employees are working in the six counties of the Great Plain dominating in food

Table 4.

DISTRIBUTION OF THE NUMBER OF INDUSTRIAL AND FOOD INDUSTRIAL EMPLOYEES IN 1984 (%)

Region	Industry (%)	Food industry (%)
Baranya	4.37	4.97
Bács-Kiskub	4.24	7.30
Békés	3.59	6.34
Borsod-Abauj-Zemplén	9.37	6.61
Csongrád	3.96	5.26
Fejér	4.73	3.44
Győr-Sopron	4.63	5.61
Hajdu-Bihar	4.12	5.93
Heves	3.26	4.46
Komárom	4.09	2.04
Nógrád	2.59	1.20
Pest	5.89	5.80
Somogy	2.15	4.25
Szabolcs-Szatmár	3.83	6.11
Szolnok	3.92	4.39
Tolna	2.26	3.35
Vas	2.63	2.86
Veszprém	4.36	2.77
Zala	2.95	3.64
Budapest	22.90	13.65
Activity outside the boundary of the country	0.16	0.02
Country altogether	100.00	100.00

industrial raw material production. This ratio is the result of rapid development, however, in some cases, it seems to remain below the optimum value, that is, several smaller or bigger districts begin to develop in the Great Plain the agriculture of which produces a larger amount of raw materials than what can be processed by the local or district food industry. For instance, there is no satisfactory harmony between vegetable and fruit production and cold-storage capacity in Csongrád, between animal breeding and meat industry in Bács-Kiskun, and Szolnok, between fruit production and fruit processing almost in the whole Great Plain, between grape production and processing in Csongrád, and Bács-Kiskun, between sugarbeet growing and sugar industrial capacity in the southern part of the Great Plain, and in the beer-making of Csongrád and of its districts. The above listing demonstrates that in Bács-Kiskun several food industrial raw materials are available in a larger quantity than the county's food processing capacity. Accordingly, in relation to smaller districts the territorial disharmony is here the sharpest.

Between 1979 and 1985 within food economy the development of food industry

was more dynamic than that of agriculture. There is a different tendency in the change of productivity. It can be explained in that today's food industry undertakes too much (very often from agriculture), such as purchase liabilities, the costs and risk of storage, quality changes, and it is often touched by the constant fluctuation of the market. It can be considered as a result that in the food industrial market, where the price level was stagnant in the whole world market, the „unit value positions" of Hungarian foods did not decrease further (6). This well indicates that by quick and flexible adjustment to the constantly changing world market, positive changes can be achieved even in a fairly disadvantageous stage of the world market. This is promoted by the modernization of the interest and organizational system which also supports productivity. In no other industry can it be so important to harmonize production, processing, putting into circulation, and marketing than in food economy. This idea is reflected by those significant structural changes which helped the firms increase their independence and acquire more authority. The adequacy of these measures is proven by the results achieved by these firms. The characteristic features of food industry suggest that results can only be achieved if flexible decision are made. The authority of decisions should be due to where there is a great deal of information and interest.

The ratio between the number of workers employed in the locally and externally supervised food industrial plants in the individual counties was quite surprising in 1980*. The data showed that on a domestic scale only 34.3 per cent of the total number of food industrial workers are supervised locally. A higher ratio was obtained only for Hajdu-Bihar and the capital; it was 36.5% in the former and 98.5% in the latter as concerns local supervision. In the other counties the values were quite similar. (The deviation was only 22.0%). Because of the closeness of the capital it is evident that the minimum ratio of the number of locally supervised workers was found in Pest, which was followed by counties Zala, Borsod-Abauj-Zemplén, and Szolnok. However, it is interesting that among the counties where this ratio was close to the maximum value were the strong industrialized (Győr-Sopron, Veszprém) and the less industrialized (Szabolcs-Szatmár, Heves, etc.) counties. There could not be found any correlation between the extent of industrialization and the ratio of the number of locally supervised workers.

When investigating the distribution of the number of food industrial workers in relation to supervision by arranging the centres in the individual counties, there can be found big differences in the ratios of the number of locally supervised workers. The maximum ratio 40.0% is obtained for Hajdu-Bihar and the minimum ratio 15.9% is obtained for Veszprém. The centres in the capital supervise locally 56.6 per cent of their employees.

National economic interests made it necessary to change this situation. A significant change was achieved by the elimination of a great part of food industrial

* The sources of the data are the plant tables from the 1980 reports of the Central Statistical Office on industrial statistics, which include 1667 food industrial plants.

trusts. Consequently, poultry, wine, sugar, tobacco, confectionery, canning, and brewing industrial firms gained total independence. By the elimination of trusts these firms were taken under the supervision of the Ministry, and therefore, they acquired much more independence. Since that time the correctness of this decision has definitely been proven.

Nevertheless, in other branches the supervision is still the right of the trusts and large enterprises, respectively, the modernization of which has become a question of interest recently.

It is doubtless that food economy, included food industry, plays an important role in the solution of economic problems. However, it should not be forgotten that due to the shortage of investment sources there are no limitless possibilities here either. The requirements can only be fulfilled by a resolute investment policy, by changing the microstructure according to the demands of the market, by economical considerations, by modernizations, and by the dynamic development of packaging. Taking into consideration the fairly disadvantageous economic conditions, it can be achieved by an intense exploration and exploitation of the internal resources and by a flexible adaptability to the ever changing circumstances.

Summary

The Hungarian food industry has developed dynamically since World War II. The food processing industry has been extended and is now capable of processing an increasing proportion of the domestic agricultural products. The manufacture of a variety of new products has recently been begun. The domestic food consumption and the volume of exports has increased simultaneously. The regional distribution of food industrial productive forces has been rationalized. The role of regions outstanding in raw material production has grown in food processing, too and the predominance of the capital in food industrial production has considerably decreased. Despite the favourable changes in food economy the individual spheres are still not in proper territorial harmony. There have been positive changes also in the supervision of firms. However, in this respect and as for further rationalization of regional structure, product groups and product structure, there are still resources the exploitation of which is one of the future tasks.

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SPATIAL EXTENSION OF A RURAL SETTLEMENT

A case study

R. MÉSZÁROS

Department of Economic Geography
A. József University, Szeged, 6722, Hungary

At any given stage of the socio—economic development there always develops a space category that can provide a frame for the fundamental spatial processes of the period in question.

In fact the realization that socio—economic processes can properly be regulated by means of adequate spatial units, has also been based on this. The organization of space has thoroughly been studied; meanwhile various space categories have appeared: economic district, attraction zone, agglomeration belt, city—group, village—group, region of small towns, etc. All of them, from some point of view or other, are separated, structured, or homogeneous natural—physical parts of space, where the most important elements are the settlements. After all geographically all of them can be described by the horizontal extension of the interrelationship of the settlements. Undoubtedly the interrelationship of the settlements through the main lines of the socio—economic spatial structure can be defined by the flow of people, materials and information.

The spatial interrelationship of a settlement, however, are much more colourful and cannot be restricted only to the external interrelationship of the settlements. Starting from the fact that the inhabitants of each settlement determine and fill in a section of space wholly or in part, through their movement patterns, intensity and aim. The individual moves in this space and it gains functional meaning from human activities. In this way the co—ordinates of the position in the division of labour can also be expressed.

The mentioned space category investigations, in fact, reveal the effects of attraction and the directions operated by certain functions. Man is usually studied in this spatial relation—system as only workforce, or sometimes consumer. Little attention is paid to the development and effect mechanisms of the directions of movements set up by the spatial flows of people. It is worth investigating what sort of space of movement is provided for the inhabitants by a settlement (in its given

condition) and what space of movement* they are forced to move in because of the functional (provisional) shortcomings. It would also be interesting to reveal the nature of time structure of these „spatial paths" or more precisely, how the directions, distances, quantities change according to different periods of time (day, week, month, etc.).

Do all these satisfactorily express or describe the essence and size of the spatial extension of a settlement?

To find a solution of this task concentrated into questions, fairly few bases are presented in Hungarian technical literature. Though the terms, spatial lane, interrelationship of settlements, space of movements etc. have been mentioned in the title of some papers, their interpretations are different.

To build the concept of the investigation were of great help first of all *T. Hägerstrand*'s publications of time—geographic model, and papers of the related scientists: *T. Carlstein* (1982, 1986), *A. Pred* (1977), *P. R. Mounfield* (1977). Besides *R. Brunet* (1972) who deals with the division of space, *A. Cliff—P. Haget—J. K. Ord* (1975) who classify the elements of the structure of space, *P. Cloke* and *I. A. Dawson* (1983) who study the interrelationships of rural space, and *A. Gilg* (1985) who describes spatial and social structure of villages from a monographic point of view.

The Investigation started in 1986, on the basis of my research experience and the willingness on the behalf of the settlements we could gain the collaboration of preliminary sampling we put together a questionnaire (it contains 50 questions in 15 question—categories) and made a survey that included the entire adult population (over 18) of the nuclei of the rural settlements.

In this paper I would like to present some important consequences that might be drawn from the information gained in *Bócsa*. 863 questionnaires arrived covering almost the entire population of the nuclei of the settlement. *Bócsa* is a typical „farmstead settlement" on the sandy areas of the Hungarian plain. A real village core has developed only in the recent decades of its long history dating back centuries. The cluster of farmsteads, referred to as *Bócsapuszta* earlier, were completely connected to *Soltvadkert* as all the institutes of basic supply were available there. The old people of *Bócsapuszta* being tired of the constant struggle with sand retreated to *Vadkert:* any successful farmer had a „own house" there. The nearly 1500 scattered farmsteads did not have a school even in the 1930s. Consequential the rate of illiteracy was almost a hundred per cent.

After World War II, although compared to earlier growth, its development was undoubtedly faster, it could not keep up to the standards of dynamically developing villages.

In 1986 the population of *Bócsa* was less than 2000 and it was nearly one and a half thousand less than in 1949. But while only a very small per cent of the population lived in the inner built—up area at that time, in 1986 nearly half of them (45%)

* *Sociology* often uses the terms space of movement, and social space of movement which are usually interpreted as the domain of human social relations where individuals can realize their own activities.
Geography defines the term space of movement as a concrete area that can be expressed by distance measures and where social and economic activities of individual or communaty take place.

did. Over the past 15 years the population of the inner area has doubled. It is worth paying attention to that more than one—third of the inhabitants are under 30, what is more, the people under 40 form a greater part of the population (these proportions are lower on the scattered farmsteads: the people under 30 comprise 22 per cent, while the ratio of those under 40 is 39 per cent.). Anyhow this demographic composition in itself is a significant local resource, it can practically be qualified as the social basis of the vitality of the settlement.

The development of this situation was helped to great extent by the fact that the large—scale migration into the settlement brought mostly people under 30, furthermore, a similar process took place in the outlying areas too. The significance of this does diminish even if compared to the moves out of the area taking place at the same time, though it also affected the population of working age, because the latter reduced mostly the population of the outlying areas. It is interesting to note that from among the studied population, 28 per cent of the inhabitants of the settlement and 48 per cent of those living in the scattered farmsteads moved to *Bócsa* after the age of 1.

Though large—scale agricultural production, an important economic basic of the village, touched the bottom in the mid 1970s, the co—operative showed a deficit, and the level of results in the special co—operative greatly fluctuated, the past 15 years can be characterized as the period of prosperity. A particular settlement forming process has been taking place, induced by a local intellectual resource, the valuable ability of sizing up the situation. Nothing special has happened other than that they have only realized and made use of those elements of the development which took place in the organizational structure and production of agriculture in Hungary and which could be integrated into the development conception of the settlement: the development of the secondary activities, the integration of small—scale production, incentive agricultural wage—system. They have also become aware of the fact that economic measures strengthening the vitality of the village, should be completed by providing facilities that improve the living conditions. They could realize the distribution of cheap house plots and give favourable credit conditions for home building. All these have contributed to the dynamic development and spatial expansion of the settlement core (the physical spatial extension of it has almost doubled).

Incidentally it is also necessary to mention that the process outlined above also proves the notion according to which the decrease of the population in a settlement is not necessarily a negative phenomenon. In this case too, the progressive change of the inner structure indicates that presumably the development of a new state of equilibrium has been taking place. Though the spatial concentration of the population has not been followed, at least not at a similar rate, by the development of infrastructure. There still is not a pharmacy, a butcher, nor a book shop and the technical level of telephone system between the settlements falls below even the very low national standards.

While at same time almost every family has a car, a motor—bicycle and 80 per cent of the inhabitants are „bicycle—owners". The agricultural „small machine

park" in family ownership is very significant and the interest in home building and production is permanently stable. This situation is the determining background of the spatial lanes of the local adult population.

The following questions of the questionnaire helped to investigate the spatial paths:
Do you live together with your children?:
If not, where do your children live?:
Do you intend to leave the village?:
If yes, where to?:
When do you plan to move?:
Have you any local relatives?:
If not, where do your relatives live?:
How often do you visit them?:
Workplace?:
Occupation?:
How do you get to work?:
How often do you go a month to:

	Kecskemét:	Kiskőrös:	Kiskunhalas:	Other settlement:
shopping				
for medical treatment				
for education				
for entertainment				
other purposes (offical, family)				

What is your main from of transportation?:
Have you a household plot or an auxiliary farm?:
If yes, how far is it from your home?:
How often do you go there a week?:
What the average length of your stay there per occasion?:
Have you a family garden?:
Is it a garden adjoining your dwelling place?:
If not, how far is it from your dwelling place?:
How often do you go to the garden?:
What is the average length of your stay there, per occasion?:
Do you produce agricultural products for the market?:
If yes, where do you sell them?:
(the name of the settlement:)
Do you transport the products yourself?:
If yes, how often?:
Do you produce anything in the garden adjoining your dwelling place for sale?:
If yes, where do you sell it?:

From the point of view of the geographical evaluation of spatial paths the analysis based on the time structure has proved to be the most practical.

Two main differentiating circumstances can be recognized in the time—division of spatial paths:

1) The quantity, the content and direction of the spatial paths of daily regularity are qualitatively different from that of the spatial lanes less frequent in time.

2) The majority of the spatial path with economic meaning are of agrarian nature, therefore they are decisively connected with the growing season, thus their intensity is modified every half year. Their operation has a certain rythm.

The spatial paths of the population of *Bócsa* fall into 6 units of time: spatial movement made daily, more times week, weekly, every fortnight (twice a month), monthly, and less than once a month. The movements rarer than a monthly frequency do not reach 1 per cent of the total movements, their role in forming the spatial extension of the village is not significant, their detailed analyses is not necessary.

Daily spatial paths

From the summed up information it is quickly observed that the spatial—path system within the settlement is extraordinarily strong (Figure 1). This is in close connection with the economic structure of the settlement. Concerning the spatial order of activity, the economic structure of *Bócsa* is closed and restricted to the outlying areas. In the inner built up area there is no significant economic unit. This spatial concentration connected to the settlement is well represented by the structure of occupation also (Table 1).

STRUCTURE OF OCCUPATION
(the share of the evaluated population, percentage %)

Table 1.

		inner built up area	outlying areas
does not work at Bócsa		6.5	11.8
work at Bócsa	private farmer	6.5	8.1
	member of the co-operative	21.1	11.8
	member of the special co-op.	21.7	22.8
	bottling plant worker	9.0	2.9
	other sector	13.8	8.8
housewife		11.2	19.8
pensioner		8.5	12.5
		1.7	1.5

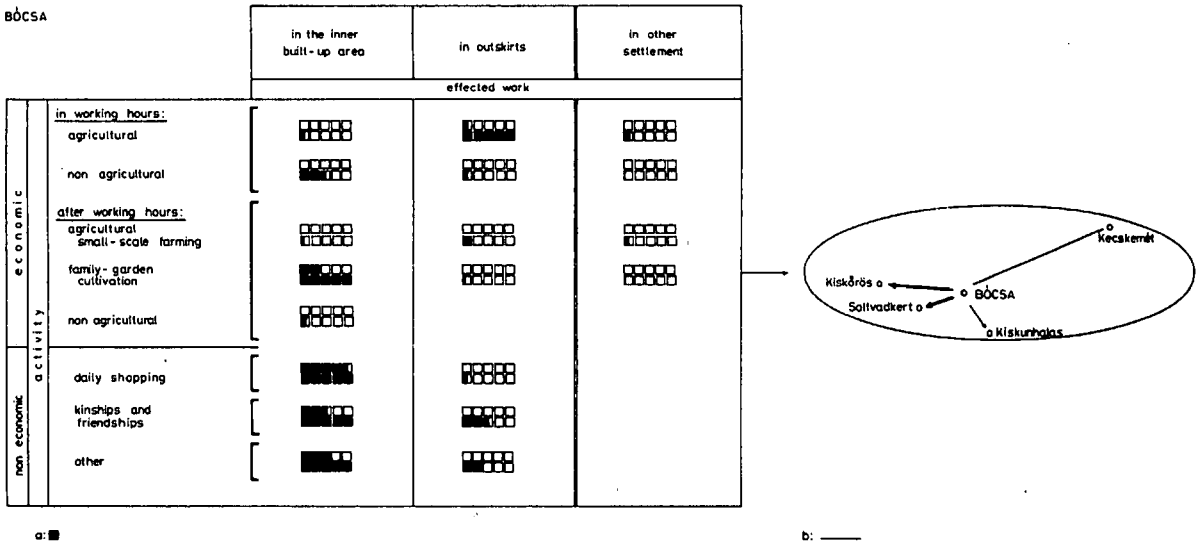

Figure 1: The spatial structure and essence of spatial paths with daily frequency
a: 10 per cent (the ratio of the activity within the given activity category)
b: 10 travel cases

The majority of (80%) of the 63 commuters altogether from the inner built up area and the outskirts move in a space (of little extension) around *Bócsa (Soltvadkert, Kiskörös, Kiskunhalas)*, which as we will see, is the basic space of movements of the other spatial lanes. (It must added that the other 20% of the commuters do not travel far to work either. They work in *Kecskemét, Jakabszállás* and *Tázlár.)*

The fact that the movement of labour force takes place in a small space is also indicated by the means of transport used for going to work: three—fourth of the workers walk, cycle, and motor—cycle to work.

The majority of economic activity carried out during the main period of work takes place in the outlying areas; the economic activity outside the normal working hors (also of agrarian nature) is instead related to the inner built up area and undoubtedly connected with small—scale garden economy. It is known that the morphology of the Hungarian village was always characterized by the garden of the family house. Earlier its main purpose was basically subsistence function, it has become a commercialized mini farm with strong specialization (vegetables out of season, flowers, and raising small animals). The new family houses having been built recently at *Bócsa* also have this functional, morphological trait (though the buildings used for small animal husbandry do not fit in with their style). These gardens of the built up area altogether, from an *agrarian space of the inner built up area* that is a significant sector of the agricultural production of the village. 92 per cent of the small gardens of *Bócsa* can be found on the plot of the family houses, 6 per cent on the outskirts and 2 per cent in the agrarian space of other settlements. The type agriculture (the great role of the special co—operatives) hindered the development of a garden zone on the outlying areas, more precisely, There was no demand for agricultural activity of this kind. It can be said that the gardening branch of small—scale agriculture binds the adult population to the micro—space of the dwelling place, except in the winter months, for 2—3 hours a day after the main working hours.

The other branch of small—scale farming (the use of householdplots, auxiliary farm) operates daily spatial lanes for a shorter period of the growing season, but it usually means an 8—10 hour engagement a week, though mostly in the outskirts. One—fourth of the household plots and auxiliary farms are less than 500 m from the dwelling place, one—fifth of them can be found between 500—1000 m, 26 per cent of them are still close, within a 3 km radius circle and only 28 per cent are situated farther than this.

The other large group of the daily spatial lanes is of a non—economic purpose. Nature one part of it is linked to the daily shopping activities (this activity attracts also the population of the inner farmstead zone to the inner built up area). The other part is formed by the spatial lanes of various relations between people. Here the family relations are worth paying special attention to, due to their sheer number. It is interesting to note and also represents the sort of closed nature of the settlement that three—fourth of the family relations are local. Even if there is no daily communication among the relatives, this mass of family relations Should be considered as a

possibility of the daily spatial lanes. Finally we should notice that a characteristic feature of all the daily spatial lanes of non—economic nature is that they do not cross the administrative boundary of the village.

Weekly—monthly spatial paths

The spatial paths of rarer frequency than the daily ones are mostly directed towards 4 settlements: *Kecskemét, Kiskörös, Soltvadkert* and *Kiskunhalas* (Figure 2). The date also show that:

— 72 people, mostly over 50, do not leave the settlement at even a monthly frequency;

— at the same time, surprisingly many people (138) get to all the 4 settlements once a month. While the distribution of the population according to sex is almost 50 per cent, more than half (58%) of those belonging to this group are under 40.

When analysing the individual time units, two marked features can be noticed. On the one hand, in each time unit there are a lot of spatial paths tending towards *Köskörös;* on the other hand the attraction of *Kecskemét* increases correspondingly to the decrease of the frequency of travel. Analysing the meaning of the spatial paths, it can be stated that the majority of the adult population of *Bócsa* leave the village to go *shopping* (Table 2).

Table 2.

THE NUMBER, MEANING AND TIME STRUCTURE OF TRAVELLING FORMING SPATIAL PATH

		Kecskemét	Kiskörös	Kiskunhalas	Soltvadkert
monthly	shopping	278	151	153	67
	for medical treatment	11	54	23	8
	entertainment	21	10	3	12
	other	22	28	12	15
twice a month	shopping	132	178	90	47
	for medical treatment	18	57	9	15
	entertainment	25	13	9	5
	other	18	19	7	24
weekly	shopping	95	137	78	141
	for medical treatment	11	39	4	12
	entertainment	23	11	7	2
	other	25	24	16	28
more times a week	shopping	13	27	11	26
	for medical treatment	4	5	3	5
	entertainment	—	4	—	—
	other	4	10	3	3

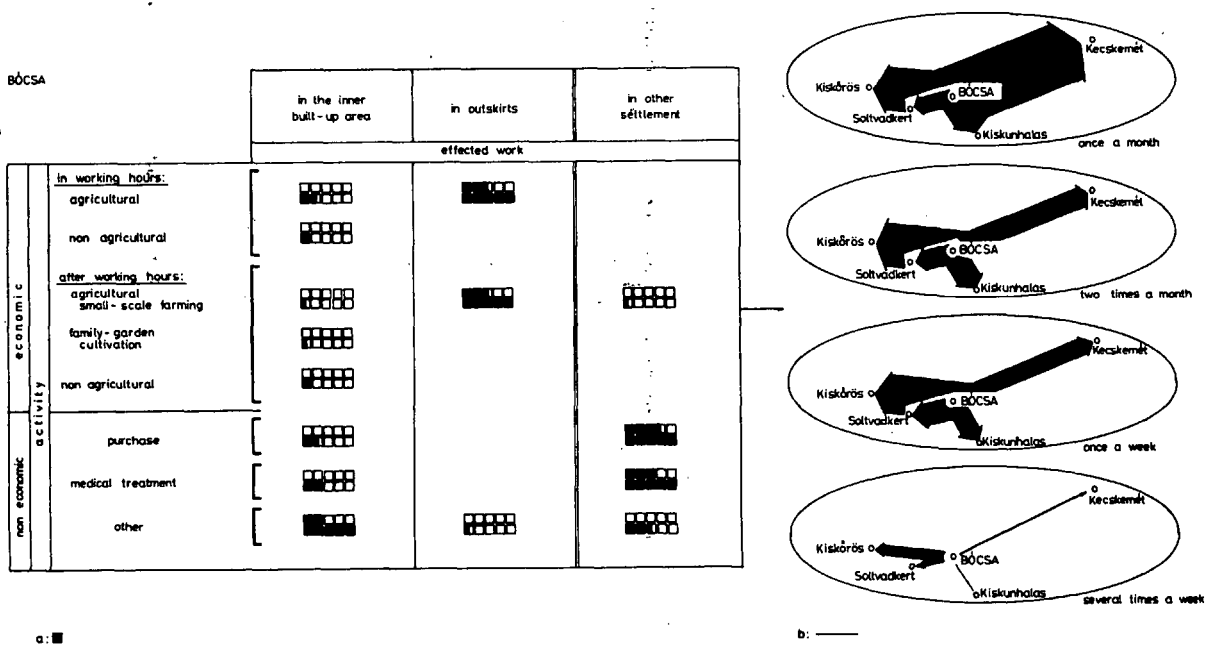

Figure 2: The spatial structure and essence of spatial paths with less than daily frequency
a: 10 per cent (the ratio of the activity within the given activity category)
b: 10 travel cases

It can be seen that the centre of *health services* is *Kiskörös*, while for *entertainment Kecskemét, Kiskörös* and *Kiskunhalas* are equally popular. The adult population's spatial paths with the purpose of *learning*, though very few, tends towards *Kiskörös*. But a detailed analysis of the questionnaires draws attention to some very important facts:

— the ratio of the population over 60 of the inner built up area is high among those who travel to *Kecskemét, Kiskörös* and *Soltvadkert*. They go to *Kecskemét* only once or twice a month at most, as for *Kiskörös* twice a month. while to *Soltvadkert* they travel weekly;
— in sharp contrast to this is that the surveyed population over 60 of the scattered farmsteads do not go to *Kecskemét* for shopping purposes;
— among the female population between 18—40, a dozen go to *Budapest* for shopping or entertainment monthly;
— travelling with the aim of entertainment was almost exclusively chosen by the 18—40 age group.

From among the travels *for other purposes*, administrative matters force the inhabitants of *Bócsa* to go to *Kiskörös* and *Soltvadkert*, but among these purposes, rather human relations (family) operate the majority of the spatial extension of *Bócsa*, too that a great part of the non—local family relations can be found in a 20 km radius circle, more significant outer cluster of relatives can be seen on only in *Kecskemét* (12%), and in *Budapest* (11%). Relatives of the inhabitants of *Bócsa* live in 20 settlements in various parts of the country (excluding Bács—Kiskun county), but this comprises only for 16% of all the non—local family relations and from extraordinarily unsystematic spatial often rarer than annual frequency.

Another factor that could deserve attention in shaping the present spatial path system, notably the spatial lane linked to the *transportation of agricultural products*. The provided information concerning the transportation of the privately produced agricultural products is not enough to draw satisfactory conclusions because very few people gave valuable data. In spite of this we can say that a great part of the agricultural products move within *Bócsa* (market, assorted procurement, winery). What leaves the village its direction is in accordance with the other external spatial paths, only *Dunaújváros* and *Budapest* deserve mentioning with a 2—3 say frequency in the pear period of selling the product in question.

The demographic process, the decrease in the population, characteristic of *Bócsa* up to now, will resumably continue in the future, too. The rate of this is modified by the prevailing external and internal impacts. At present 82 persons (47 from the inner built up area, 35 from the outskirts) plan to move away from the village in 5 years. This intention of leaving is a very important factor because it is a sort of manifestation of the present attitude to life in the expectable spatial behaviour of the individual. From the point of view of *Bócsa*'s future development it might be an important fact that on one hand one—third of those intending to move away is under 30; on the other hand 60% of all those leaving are women.

Thus it can be stated, with a little exaggeration that masses of young women intend to leave the village. In the first approach it calls attention to the possibility

that the number of potential, new families in *Bócsa* will decrease and might cause demographic problems in the long run. Among the „target settlements" *Kecskemét* and *Soltvadkert* are the most popular. As a consequence the majority of the people intending to leave the village also move in present spatial paths and plan to have their new homes in the target settlements of the spatial lanes.

Conclusions

1) The main direction of spatial movements of population determine spatial paths, s group of which stays within the administrative boundary (The traditionally interpreted spatial extension) of the settlement, while the other group crosses it. The majority of the population take place in the forming of the spatial path of both types.
2) The spatial paths leaving the settlement express the output conditions of the interrelationships of the settlements, which, mainly outlines the size of the spatial extension and the functional meaning, deriving from the condition of the settlement. Thus space definable in this conception can be identified with the spatial extension of the settlement, formed by its population. To determine the actual spatial extension of a settlement, it is certainly necessary to make use of the spatial paths of the other two elements (substance and information flow) of output conditions.
3) Knowing the frequency—composition and meaning of the spatial lanes, some concrete cases of the spatial structure of the regional distribution of labour and the functioning mechanisms of the interrelationship of the settlements have become more thoroughly analysable.

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PECULIARITIES IN THE PROCESS OF URBANIZATION ON THE GREAT HUNGARIAN PLAIN

J. TÓTH

Hungarian Academy of Sciences
Research Center for Regional Studies
Pécs, 7621, Hungary

The characteristic features of the urbanization process of the Hungarian plain has been one of my main research field of the past two decades. The partial result of the research, beside other scientific journals, have appeared in the annual Acta Geographica Szegediensis. Now I have made a summary of my investigations up to this point.

The main characteristic features of the urbanization process of the Alföld (Great Plain) derive from the specific historical development, the relative backwardness and the comparatively late growth of the region.

The natural endowments, the type of economy, the characteristic features of the settlement system and the territorial differences within the region enchance these principal features further. Compared to other regions, differences are not just the matter of being behind the times. The Hungarian Great Plain does not follow the development of other regions; the urbanization process in the future will also have distinctive differences. The present transformation of our settlement and regional development strategy requires talking these facts into consideration much more now than ever before.

In the following I summarize my research work in a point system. I think that my theoretical statements plus those connected with the characteristic features of demography, settlement, spatial structure and the conclusion, can be utilised in the elaboration of a development strategy of the Hungarian Plain, which is in compliance with the Hungarian long term social goals and also takes the regional potentials and interests into consideration.

Theoretical statements

1) The development of the productive forces shows not only territorial disparties but also sectoral unevenness. Centres and peripheries, as inevitable counter-types, are formed in the economic space as a result of the fact that the particularly favourable socio-economic constellation influenced by the natural endowments, concentrate the most dynamic branches of economy regionally, and all other branches in close territorial relation with these quickly developing ones, also undergo a rapid development. The use of „central-periphery" model is very frequent in both the international and national economic analyses. (For example: *Berend, T. I.*

— *Ránki, Gy.* 1979) The parts of the centre-periphery notion pair are relative categories: the same element of the economic space can be periphery on one level and centre on another level and in another relation-system. The spatial structure of a country is the complexity of centres and peripheries at different levels with complicated relation system, in which a hierarchical order can be seen, also reflected in the structure of the institution system.

The centre determines the growth rate of economy, the nature of development and its regional relations.

Thus it has an advantage of being more highly developed than the periphery and its development is in the interest of the whole country, because of the faster results, greater efficiency and its influence upon the peripheries. Not negligible are the immanent interest of the institutions concentrated in the centres.

The periphery on the whole, compared to the centre, can be said to be backward. This being behind the times can be revealed, beside the economic sphere, in the peculiarities of the demographic composition, living conditions of the population and also the representation in decision making.

The periphery type includes both the spatial distance from the centre (economic) and being behind the times. The latter means that those processes which have completed in the centre may be just commencing in the periphery.

Therefore the development of the periphery is not just simply the belated repetition of that of the centres but is, instead, of a different nature.

The Great Plain, which inherited backwardness historically,undoubtedly showed striking progress after World War 2, but in spite of this, compared to the centre extending around Budapest and the industrial axis, it has remained a periphery, what is more, certain areas within the Great Plain region have become the „periphery of the periphery".

2) Urbanization can be defined as a process running parallel with the development of the productive forces and the widening and deepening distribution of labour, therefore:

a) urbanization is an uninterrupted process — though varying in intensity — which runs parallel to the development of the productive forces;

b) it is an all embracing process affecting settlements from the separate smallest forms to metropolitan agglomerations;

c) it involves the mobility of the population (the most important labour force) into activity groups of different character;

d) it includes the regional concentration of population;

e) it covers the changes in the way of life of the population which is a direct consequence of the changes in occupation and residence;

f) urbanization contains the altered level and structure of demands of the population from environmental viewpoint.

From our interpretation it emerges from other things that the intensity of the urbanization process may divert spatially to a great extent. Progressive and regressive phase may alternate each other in the process in complience with the development of the productive forces. This and the accompanying regional differentiation

appear even in a small country like Hungary. This primarily is in connection with the fact that kind of role certain regions of the country play in the spatial structure of the national economy. The urbanization process in some areas may remain behind while in other regions it enjoys a period of exceleration, compared to any former eras depending on the changes of the economic, political and geographical situation of the country and the reevaluation of the natural resources.

Therefore the concrete measures, plans and conceptions in connection with the urbanization process cannot overlook the fact that as a consequence of earlier characteristics of the development, the urbanization process in different areas are at diverse levels. As a result the impact of the measures, the areas concerned react differently.

A settlement, in the given geographical environment, can be defined as a system of the socio-economic and technical structures (spheres) intensively interacting with the elements of the geographical environment. In an optimal case, which suppose a harmonious development of certain structures, this concept can be demonstrated by a Tetrahedron.

The base of the tetrahedron is the geographical environment, the other three sides are the economic, social and technical (infrastructural) spheres respectively. Along the edges the intensity of the interaction between the spheres (structures) depends on their level of development. The settlement is the system of all these structures and their interactions, which is in strong interrelationship with the natural environment both as spheres and a uniform organism. Conceiving a settlement in this way (considering the settlement-environment relation), the following can be stated:

a) the development (complexity) levels of the spheres are different;
b) the dynamism of development of the structures differs;
c) in the long run and as a tendency, there is more or less a correlation between the development level and the dynamism of structures;
d) the whole structure can be modified by the change of the elements of the structures (their accelerated development or their decline, or perhaps by the appearance of a new element;
e) this modification influences in an indirect way the system of structures (of the whole settlement);
f) the complexity level of development, the structure-systems (the settlements) and their dynamism are different.

The development of the productive forces and the urbanization process help strengthen the interrelationship between settlements. The settlements loose their earlier independent status and form a unified settlement system. Thus a settlement network forms, in which the higher development level of the productive forces and the more advanced the urbanization process, the stronger are the interactions of the individual elements.

Within the settlement network the towns and villages can be separated functionally and according to the complexity level of the structure system. The investigation and

interpretation of the settlements can only be worthwhile by revealing the concrete regional concerns and the concrete spatial structural interrelationship.

3) We consider the environment as that part of the Earth's biosphere where the settlement functions and beside natural laws, social influences, also come across modifying the former impacts. As a result of this conception of environment (considering settlement-environment relation), the following can be accentuated:

a) the elements of the geographical environment are in direct relationship with all the three structures of the settlement;

b) this is an interrelationship:

certain elements of the environment influence the development of the structures, while the structures in turn react upon the environment;

c) the operation of the system transforms the geographical environment with different intensity and to various depths;

d) the altered environment responds in a different way upon the settlements;

e) in the environment of the settlement, beside the modified natural process, the socio-economic and technical influences come across more and more;

f) the intensity of these effects is in proportion to the size, development and complexity of the settlement;

g) the nature of the effects can be differentiated according to the types of the settlements;

h) with the growth, development and functional transformation of settlements, the rearrangement of constituent structures, different elements of the geographical environment may become of greater importance;

i) at the present level of the productive forces in Hungary, the demand for the environment which provides favourable living conditions can be considered a general one;

j) the protection, the purposeful transformation and reestablishment of the environment and its elements requires a complex approach and environmental management.

With the formation to the settlement network and the utilization of the environment as a whole the impacts on the environment are becoming more and more universal and intensive. In contrast, compared to the previous situation characterized by a geographical environment where natural laws operated uninterruptedly, and the settlement-environment interrelationship was isolated, a uniform relationship between settlement networks and environment has been established.

In this new environment zones and centres of intensive settlement-environment interrelationship are surrounded by areas of less intensive interrelationships, though the are organic parts of the interaction zone.

4) In regards to the structure, rate and direction, the development of a region depends upon the role it plays as an economic-spatial unit in the regional distribution of labour of the national economy. As a result, the settlements of the region concerned enjoy development, because the population, the majority of the socio-economic activities takes place in the area concerned and the infrastructure also concentrates in them.

Consequently there is an essential interrelationship between the regional and settlement development. The texture of the region, either from an economic, social or technical point of view, appears mostly through the settlement network. Therefore the co-ordination of the regional and settlement development have to be insured but the present Hungarian institution system, primarily because of its sectoral disunity, is unable to provide this to a great extent.

The population geographical aspects of urbanization

1) In the period of accelerated socio-economic changes following World War 2, all those circumstances which influenced the position of the region in the regional distribution of labour in Hungary and those which maintained the peripheral situation of the Great Plain, also asserted their influence upon the demographical processes.

At present the number of the population living in the Great Plain is half a million less than could be expected on the basis of the indices of the natural increase; consequently the out-migrants belong to the more mobile, younger, more educated and trained, therefore demographically and socially more valuable part of the population. The consequences of this have caused an only slowly curable deformation in the demographical structure of the Great Plain. Also it has contributed to the conservation of its peripheral nature reducing the chances of its elimination.

2) The share of the Great Plain in the total number of the population in Hungary rapidly decreased following the liberation (1945) of the country and at present it has reached the bottom in spite of the fact that the relative situation of the region improved in the past decade.

There are essential differences in the change of the number of population between the studied periods. In the 1950s the number of the population in the macro-region increased and the natural increase exceeded the migration loss. During this time the population of the villages was not decreasing at a rapid rate, though it was the only region of the country which showed any decrease at all. The 1960s (especially the first few years) were the period of the most rapid interregional population redistribution in Hungary. This had an especially disadvantageous influence upon the Great Plain: nearly 10 per cent of the population of the villages was lost during this period. At the same time the growth rate of the urban population was still under the national average.

In the 1970s, in spite of the fact that there was no essential change in the demographic indices and the make-up of the village population, the relative situation of the region improved as a result of the accelerated growth rate of the urban population. In the light of the demographic processes of the 198os leading to a loss in the national population, this improvement proved to be very transitional: the structure of population compared to the national composition has made its effect felt, though with intraregional differences.

3) The demographic differences have increased between the regions of the Great Plain. On the whole population centre of the region has shifted toward the north. The traditionally high natural increase of the population of the Northern Territory Beyond the River Tisza and the spatially differentiated ratio of out migration also play a role in this.
In some regions, like Sárrét, Tiszafüred and South-Békés, out-migration has grown out of proportions, sometimes exceeding 50 per cent. Compared to the general situation of the region, a dynamic development of the cities can be seen; they have become the focal point of intraregional in-migration and this way, the places of spatial concentration of the population. Significant and spatially differentiated changes have taken place in the outlying areas, too.
4) The level and rate of the process of urbanization is well reflected by the structure of occupation and the rate of its transformation. The driving force of the occupational restratification on the Great Plain was industry, (as well as, in other parts of the country) though compared to the national average, it was a belated and a much slower process. Recently the role of industry has been taken over by the tertiary and quaternary functions, first on those towns with a more harmonious structure. Agriculture still plays a greater role, compared to the national average, in the occupational structure of the population in the Great Plain. The value of the C coefficient, which shows the rate of restratification and the relative population concentration, is the lowest in the surroundings of the city (cores), while in some peripheral areas (Szatmár, Bihar, Nagykunság, South-Békés) it approaches 1 as a consequence of the slow restratification. The values of some earlier industrialized towns indicate the inception of a new type of equilibrium (for example: Baja, Kalocsa, or Szolnok, Szeged). In the latter two cities the ratio of the people with agrarian occupations has grown.
5) As a result of the large-scale out-migration the age structure of the population in the Great Plain has deteriorated at a significantly faster rate than the national average. The changing of the aging index (the ratio of old people and children) shows that in 1960 in a great part of the settlements of the Great Plain, especially in the villages (regionally it includes two-thirds of the territory east of the Tisza in the north and the Danube-Tisza Interfluve) the situation was more favourable compared to the national average (0.54), and there were hardly any settlements where the ratio of old people over 60 was higher than that of the children. By 1980 the values of the aging index indicated polarization.
The northern part of the Trans-Tisza Region continues to have a more favourable age structure compared to the national average (0.78), moreover, the Nyírség, within the area, has even a better composition of population according to age than the national average in 1960. In other parts of the Great Plain there are hardly any areas with a better age structure when compared to the average: moreover, the situation of some areas (Sárrét, South-Békés, Bácska, Jászság) that are just becoming peripheral is striking in regards to their demographic indices.
6) Over the past few decades significant changes have taken place in the educational level of the population, too. The Great Plain has also followed this process,

although with a relatively little lag, meanwhile the intraregional differences have survived. There are some regions (the area between Debrecen-Nyíregyháza-Mátészalka and around the Danube-Tisza Interfluve) where extensive settlement groups can be found with a population of lower educational level than that of the national average in the villages. Thus among others, the chances of these areas are further diminished in the innovational process.

7) The accelerated process of urbanization of the past few decades has change the earlier situation: compared to the traditional circumstances in which the village with a younger age structure and higher natural increase opposed the town having just the opposite demographic features, at present the towns have become (though to different extent, showing intraregional disparities) the determining factors of demographic processes and the targets of in-migration.

Settlement geographical aspects of urbanization

1) There stages with different characteristics can be distinguished in the impact of the urbanization process on the settlement network after the liberation of Hungary (1945): the 195os were a relatively calm period, the 196os experienced impulsive changes essentially (and disadvantageously) modifying the structure; a new phase started in the 197os from which we hope to develop a more harmonious settlement system and to restrain concentration.

2) Compared to other Hungarian towns, the former market towns once playing a leading role in the settlement structure of the Great Plain, were structures set up of more simple retrogressive spheres in accordance with the socio-economic development and the role the region played in the regional distribution of labour of the country in which they were functioning. Beside backwardness harmony is to be stressed in another context, too: there was conformity between the underdevelopment spheres of the structure of the market towns. The contradictory quicker development of the Great Plain, when compared to past conditions, have disrupted this harmony and reshaped the traditional structure of the market towns in an intraregionally differentiated way. The re-establishment of the harmony of the new structure at a higher level is required by the local and regional interests.

The chances of the market towns for further development in the new phase of the settlement development are dependant upon both the national tendencies and possibilities, and the change in the role of the Great Plain plaued in the regional distribution of labour. The local factors will also play a role of increasing importances.

3) The giant villages and the real or potential small towns form a historical settlement type, characteristic of the settlement system of the Great Plain. At present this settlement type is undergoing a regionally differentiated transformation. There are three categories which represent the various stages of the development affecting settlements from the giant villages of conservative structure to the dynamic small towns:

a) the „Szeghalom-type" with developing functions, own potentials and an independent attraction zone; it also enjoys central subsides;
b) the „Mezőberény-type" which joins to another, more dynamic centre, thus developing by borrowing other potentials;
c) the „Vésztő-type" which has hardly transformated from its giant village nature; it can rely on only the local potentials.

The aim of the development is to encourage the development of the settlements into small towns where this process has not yet taken place, or not yet finished and strengthen those where the settlements have already attained a higher phase of this process.

4) The most decisive impact on the settlements typical of the Great Plain, (the 'tanyas', scattered farmsteads), has been the rapid and regionally differentiated elimination of them. At the same time,the living a condition in the more established farmsteads in the Danube-Tisza Interfluve, in the proximity of towns, have substantially improved.
The „tanyas" have also changed morphologically, and their functions are becoming more and more many-faceted.
Though, taken as a whole, the role of „tanyas" in the agricultural production is important, nowadays a part of them are the residences of families which hardly depend upon the traditional agricultural production. „Tanyas" have been transformed into „second homes" and are also becoming more and more numerous.

5) As a result of the urbanization process the interrelations between the settlements are becoming more varied and stronger. Three stages can be distinguished in the development of the interdependent, co-operating settlements covering smaller or larger areas: the settlement group, the conglomerate of settlements and the agglomeration. Very few examples of the latter can be found in the Great Plain, according to the urbanization level, but the first two stages of development are represented more.

6) The conglomerate of Mid-Békés settlement thoroughly investigated, is the most developed settlement conglomerate of the Great Plain and it also plays a significant role in the spatial structure of the country.
A new type of regional development plan of the area, which makes use of the results of the investigation, is under elaboration.

7) In connection with the general situation of the region and its role in the regional distribution of labour of the country, the rate of home construction in the Great Plain was lower than the national average, though towards the end of the period it came close to it. Consequently the inhabitants of this region were forced to make greater financial efforts of their own to improve the housing shortage. Because state central home-building and the construction of the subsidized flats was concentrated in the towns to a greater extent than usual therefore, for a long time, the villages with a population of even 10—20000 were exclude from the circle of the favoured settlements.

8) The National Settlement Network Development Conception (Országos Településfejlesztési Koncepció (OTK), 1971), greatly influenced — also inconsist-

ently — the urbanization process of the Greta Plain. The OTK, because of its uniform nature, could only at artificially be adapted to the peculiar settlement network of the Great Plain. In many ways, in this part of the country it hindered rather than developed the self-development of the settlements.

9) The new phase of the settlement development of Hungary and the urbanization process in general, started at the beginning of the 198os. It can objectively be characterized by the fact that the large scale territorial movements of the population have decreased; so instead migration has changed to a movement between the centre and its attraction zone. The development of the new process is supported by increasing the independence of the settlements significantly, and upgrading the role and proportion of local resource.

A characteristic feature of the new phase is that all these changes are yaking place in a period of economic development which is struggling with structural problems. In spite of this, the new phase shows promise that a settlement policy massed on the regional peculiarities of the Great Plain will develop.

The spatial-structural aspects of urbanization

1) The socio-economic changes following the liberation of Hungary (1945), the situation of the Greta Plain in the country characterized by an altered political-geographic location, put an and to the relative homogeneity nature of the region and differentiated the economic space.

At present a distinct frame of the spatial structure of the Great Plain has developed in which the most important elements are the towns and those areas of dense texture around them, and the belts developing along the most important transportation lines.

Compared to their environs these spatial structural elements have a more dynamic structure and rate of development. They also show the spatial picture of urbanization of the Great Plain.

2) The areas between the foci and lines of the spatial structure are connected with the former, but their texture is looser, their development is slower and their structure preserves a lot of conservative features. From among these regions of peripheral and disadvantageous location those being close to the national boundaries deserve special attention. (There also exist peripheries along the country boundaries proving the limits of our county system.)

3) The attraction zones joining to the towns which have a decisive role in the spatial structure of the Great Plain, consist of less but more populous settlements — in accordance with the peculiarities of the settlement system of the Great Plain — therefore the medium-rank functions give the connecting power. In other regions the texture of the attraction zones is looser than in general; from among the usual intensity zones, the agglomeration area can be found only in the case of the largest centres. Extensive, however, is the transition belt attracted by more centres.

4) Within the Great Plain 13 spatial-structural units of different size and population can be distinguished on the basis of the results of the investigation.
These units represent different intraregional variations of the urbanization process. The differences of the socio-economic structure and the level of their infrastructural development, the peculiarities of the natural environment and their spatial relation system separate these units, therefore self-development concepts based detailed investigations are required.
5) Compared to the national rural average the Great Plain gets permanently and substantially less, through the process of central distribution, from the development resources. This is an intolerable situation, which is not only an ethical question: it is also supported by economic arguments which are unavoidable if we take it to account.
6) The differences, in some cases, increasing between the Greta Plain and other parts of the country and the differences within the Great Plain (decreasing) refer to the necessary of a uniform economic and regional-settlement development strategy based upon the regional characteristics. There exists a „Greta Plain" interest even though its institution system has not been developed yet. The real co-operation of the counties of the Great Plain in the interest of more efficient development and assertion of the „Greta Plain interest" would also be a great help.

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THE EFFECTS OF MARITIME LAW ON INTERNATIONAL FISH PRODUCTION AND TRADE

ADEL ALI RAGHEB RADY*

Department of Economic Geography
A. József University, Szeged, 6722, Hungary

71% of the earth surface, that is an area of 362,000 square kilometres, is covered by seas and oceans.

The significance of the exploitation of the fishing areas has been duly recognized only recently. However, the latest statistical data show that 25—30 million people are already employed directly in fishing (Gunda, 1984). According to FAO data, the total number of people working in areas connected with fishing is 100 million (AFFP, 1983). The majority of them work in developing countries, using traditional technology. In these developing countries, fish is one of the most important protein sources. In Asia, for instance, fish accounts for 36% of the total consumption of animal protein. In three-quarters of the developing countries, that is in 39 countries, fish accounts for 20% of the total animal sources. In certain East or West-African countries, the figure is even higher than 50% (FAO, 1984). When all the countries of the world are considered together, fish accounts for a substantial proportion of the total protein consumption: 24%. For comparison, it may be mentioned that the other kinds of animal protein provide 40%. Sea-fish constitutes 85% of the fish consumed by humans.

This whole Field currently requires extremely fast and effective measures. One such step is the control of the fishing areas through the newly formulated maritime law, the results of which have already brought about significant changes.

The maritime law and the efforts of the United Nations Organization

Since 1958, the UNO has been making efforts to stop the large fishing companies exploiting the fish stocks of the world. The stocks were controlled by the large companies, which fished along the shores of the developing countries. The following factors were mentioned in the summary of the first United Nations Organization conference, held in Geneva in 1958:

— territorial waters
— high seas

* Scientific scholar of Hungarian Academy of Sciences

— fishing
— protecting the fish reserves of rough seas
— continental shelf

The sixth point dealt with the problems which aries in the course of solving the conflicts connected with fishing. however, the solution arrived at were only theoretical ones because most of the developing countries still had a colonial status at that time *(Abdul Amir*, 1983). In 1970 a new concept emerged the „world food crisis", which became a subject frequently discussed at various world conferences. Another problem for the developing countries was that their stocks of fish were exploited along the coast by the large companies. It was also then that the conflict between Iceland and Great Britain started, the „fish-war".

At that time, the problem of the maritime law was debated at the conference of the Third World Countries (Venezuela, 1974).

At this conference a concrete decision was taken concerning the distribution of fish stocks among the coastal countries. The efforts bore fruit, for by 1980 all countries accepted and adhered to the decision.

In the course of the 6th UNO General Assembly, held in 23rd May 1977, the Secretary-General proclaimed in this introductory speech that the Organization would take an active part in supporting the formation of the new world economic system insofar as the maritime law made it possible for the coastal countries to utilize the fish stocks to a distance of 200 nautical miles from the shore. As a result of this, the fish production by the developing countries could be expected to increase, and the production by countries with large fishing companies to decrease, on account of the loss of their free fishing areas. This is explained by the fact that 90% of the fish stocks are located in the coastal zones.

In 1977 the total amount of fish production in the world was 68.2 million tons, broken down into 37.8 and 30.5 million tons by the developed and the developing countries, respectively. The difference was 7.3 million tons when the new maritime law was passed. In 1983 the world production was 76.5 million tons, broken down into 39.9 and 36.5 million tons by the developed and the developing countries, respectively. This indicates a difference of only 3.4 million tons. The decrease in the difference is due to the new maritime law (Table 1).

As a result of the maritime law, some countries have lost their fishing areas, while other, mostly developing, countries have gained substantial new fishing territories (FAO, 1983). The Table illustrates that the local fish production has increased, but it has declined in areas farther from the shore. The reason for this is that fish-producing countries have increased their stocks of fish near the shores, while in more distant areas intensive fishing has reduced the stocks. (This is shown in Table 2, where the figures are given in 1,000 tons.)

In developing countries fishing provides employment for more than 12 million people, and about the same number of people make their living by producing fishing equipment and by fish trading.

Table 1.

PRODUCTION OF FISHES IN THE WORLD DURING THE YEARS 1977—1983 (IN THOUSAND TONS)

Geographical distribution	1977	1978	1979	1980	1981	1982	1983	1982—1983 % change
World total	68224	70154	71060	72009	74777	76464	76471	+0,01
Developed countries	37756	37311	37136	38233	38826	39203	39957	+1,9
North America	4216	4786	4926	4982	5184	5391	5480	+1,7
Western Europe	12073	11439	11162	11250	11301	10887	11132	+2,3
Eastern Europe and USSR	10562	10062	10195	10705	10779	11216	11163	-0,5
Oceania	208	216	227	228	254	286	310	+8,4
Japan	10123	10179	9945	10427	10676	10775	11250	+4,4
others	574	629	681	641	632	648	622	-4,0
Developing Countries	30468	32843	33924	33776	35951	37261	36514	-2,0
Africa	3630	3613	3406	3321	3472	3283	3565	+8,6
Latin America	6843	9033	10261	9675	10605	11416	9165	-19,7
Near east (Asia and Africa)	655	725	897	992	1011	1039	1122	+8,0
Asia	19250	19341	19239	19659	20734	21420	22538	+5,2
others	90	131	121	129	129	104	124	+19,2

Table 2.

CATCHES (1000 TONS) BY LOCAL AND LONG-RANGE FLEETS IN SELECTED REGIONS IN WHICH FISHING BY COUNTRIES OUTSIDE THE REGIONS IN PARTICULARY IMPORTANT

Area	1970—74		1975—79		1980		1981		1982		1983	
	Local	Long Range	Local	Long Range	Local	Long Range	Local	Long Range	Local	Long Range	Local	Long Range
NW Atlantic	2014,5	2209,0	2125,8	1040,2	2560,3	307,1	2537,1	290,7	2507,3	294,7	2456,9	251.9
% of total area catch	47,7	52,3	67,1	32,9	89,3	10,7	89,7	10,3	89,4	10,6	90,7	9,3
EC Atlantic	1144,5	1935,4	1268,9	2108,6	1284,8	2147,6	1382,4	1855,6	1405,8	1800,5	1551,7	1620,8
% of total area catch	37,2	62,8	37,6	62,4	37,4	62,6	42,7	57,3	43,8	56,2	48,9	51,1
NE Pacific	509,7	1882,3	651,0	1407,3	797,1	1177,5	989,7	1383,6	1002,9	1157,3	1200,5	1291,5
% of total area catch	21,3	78,7	31,6	68,4	40,4	59,6	41,7	58,3	46,4	53,6	48,2	51,8

Resource: FAO Review of the State of World Fishery Resources. Fish. circ., (710) Rev. 4, Rome, March 1985. p.39

The areas gained after the passing of the maritime law are of great importance for the developing countries, since they do not perform such intensive fishing as the developed countries do (due to the lack of the desire technology). Thus; the areas used for fishing can regenerate and later, when the desired equipment becomes available, these sources can be utilized. Due to the maritime law, the fish production by developing countries has on creased substantially. These countries have therefore set out to develop their fish products and their fishing industry. However, member-states of the Common Market are trying to deter them by setting excessive quality requirements for the products coming from the developing countries, and also by imposing too high taxes on their products; in this way, they hope to force the developing countries to export fresh fish, which would enable the fish-processing factories of the developed countries to continue operating.

Structural changes in international fish trade between 1980 and 1983

Total production of the world

The total production increased from 72 million tons to 76.4 million tons from 1980 to 1983, thus resulting in an annual increase of 2.1%.

The export production of fish and fish products in the exporter countries in the world increased from 10.1 million tons in 1980 to 10.8 million tons in 1983. The rate of the annual increase was 1.1%. Consequently, the importer countries paid 15,905 million dollars in 1980, and 16,609 million dollars in 1983. The annual increase was 1.5% (Table 3).

Production by the developed countries

The developed countries fulfilled the following proportions in international fish production (expressed in terms of money).

The *imports* were 84.9% in 1980, which increased to 87% in 1983. The rate of annual increase was 2.3%. The *exports* decreased from 60.5% to 57.1%. Thus, the rate of the annual increase was -0.8%.

The index of the difference between the export and import production shows a deficit in this period: 4,311 million dollars in 1980 and 5,456 million dollars in 1983. the annual increase of the deficit was 8.9%.

Production by the developing countries

The production by the developing countries compared to the total world production was as follows, expressed in terms of money. The *imports decreased* from

15.1% to 13%. The annual increase was -3.2%. The *exports* increased from 39.5% to 42.9% during the same period of time. The rate of the annual increase was 4.1%.

The index of the difference between the export and import productions in 1980 was 3,613 million dollars, while in 1983 it was 4,587 million dollars. The annual increase was 9% (Table 3).

This positive change is explained by the effects of the maritime law, which extended the fishing territories and thus increased the exploitable sea areas of the developing countries, and at the same time decreased those of the developed countries. It became possible for every sea-fish producing country to enlarge her own fishing territories. The total production by the developing countries increased from 33.8 million tons to 36.5 million tons. The annual increase was 2.7%. The annual growth of production by the developed countries in the same period was only 1.5%.

Production by Arab countries

The production by Arab countries during 1980—83, expressed in terms of money, was as follows. The imports increased from 1.4% to 1.5%. The rate of the annual increase was 3.1%. At the same time the exports increased from 1.6% to 2.8%. This means an annual increase of 30%. the index of the difference between the exports and imports increased from 3.1 million dollars to 193.3 million dollars, thus *resulting in an annual increase of 2040.9%* (Table 3).

This dramatic increase was presided by the maritime law. It therefore illustrates well the positive effect of the law on the production by the Arab countries. The reason for this positive effect lies in the possibilities of utilizing the extended sea territories and thereby increasing the exports. Naturally, this resulted in a flow of hard currency into the Arab countries, which contributed largely to the rise of the national income.

Comparison of production by developing and developed countries with the help to Table 3

Imports: The imports by the developed countries increased by 2.3% per year, while those by the developing countries decreased by 3.2%.

Exports: The exports coming from the developed countries decreased by 0.8% annually during this time, while the developing countries showed a 4.1% increase in their exports.

The maritime law states that every coastal country can possess her own fishing territory, which can extend to 200 miles from the shore. Thus, the law put an end to the exploitation by the developed countries of the fishing territories belonging to the developing countries.

The developing countries may choose between two alternatives: if thyme possess the required technology, they can export fresh fish and use the profit thus made, or they can transfer the right to fish production to other countries in return for taxes.

Table 3.

EFFECTS OF "THE LOW OF THE SEAS" ON THE FISH-PRODUCTION, THE IMPORT AND THE EXPORT IN THE DEVELOPED, THE DEVELOPING AND THE ARABIC COUNTRIES (1980—1983)

Production	World	Developed countries	Developing countries	Arabic countries
1980 total productuin (tons)	72008296	38232558	33775738	990472
1983 total production (tons)	76470639	39956647	36513992	1162387
(1980—1983) increase of the production in %	6.2	4.5	8.1	17.4
annual increase in %	2.1	1.5	2.7	5.8
1980 total import (tons)	9826912	7276833	2550079	171161
1983 total import (tons)	10167041	7898527	2268514	275999
(1980-1983) increase of the import in %	3.5	8.5	-11.0	61.3
annual increase in %	0.6	2.8	-3.7	20.4
1980 total export (tons)	10137512	6321443	3816069	183697
1983 total export (tons)	10780025	6719376	4060649	510243
(1980-1983) increase of the export in %	6.3	6.3	6.4	177.8
annual increase in %	1.1	2.1	2.1	59.3
1980 deference (tons)	310600	-955390	1265990	12536
1983 deference (tons)	612984	-1179151	1792135	234244
(1980-1983) change of the deference	97.4	23.4	41.6	1768.6
annual increase in %	32.5	7.8	13.9	589.5
1980 import (thousand dollars)	15905953	13511129	2394824	233034
1983 import (thousand dollars)	16609468	14442907	2166561	255002
(1980-1983) increase of the import in %	4.4	6.9	-9.5	9.4
annual increase in %	1.5	2.3	-3.2	3.1
1980 export (thousand dollars)	15207993	9200429	6007564	236141
1983 export (thousand dollars)	15740249	89862426	6753823	448339
(1980-1983) increase of the export in %	3.5	-2.3	12.4	89.9
annual increase in %	1.2	-0.8	4.1	30.0
1980 deference(thousand dollars)	-697960	-4310700	3612740	3107
1983 deference(thousand dollars)	-869219	-5456481	4587262	193337
(1980-1983) change of the deference	24.5	26.6	27.0	6122.6
annual increase in %	8.2	8.9	9.0	2040.9

Resource: 1. FAO Yearbook of Fishery Statistics-Catches and Landings. Vol. 56 Rome, 1983.
2. FAO Yearbook of Fishery Statistics-Fishery Commodities. Vol. 57 Rome, 1983.

For example, the fish reserves in the area of the East-Middle Atlantic Ocean are estimated to be about 4.5 million tons. An amount of 2.5 million tons may be caught without causing damage to the reserves (*Hussain*, 1981). Morocco and Mauritania have the right to do fishing in this area. Morocco in possession of the required technology, produced 440,000 tons in 1983, so she can enter into export contracts with various developed countries who in turn provide an adequate position for Morocco in the world market. On the other hand, the annual production by Mauritania was only 53.8 thousand tons, because of the lack of the proper fishing technology. Thus, Mauritania chose the second of the above-mentioned possibilities and transferred her fishing rights to other countries. However, her profits from fishing still increased considerably: in 1978 the income was only 20 million dollars, which increased to 159.5 million dollars by 1983. This example clearly illustrates the effect of the maritime law.

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THE FORMATION OF DEMOGRAPHIC SITUATION OF A RURAL SETTLEMENT CONCERNING ITS POPULATION'S MIGRATION

GABRIELLA OROSS

Teacher's Training College
Szeged, 6722, Hungary

The development of the network of the Hungarian settlements, the settlement policy as well as questions of development arouse the interest of wide range of people, sociographers, economists, the mass-communication as well as public opinion deals with it alike. It's easy to understand as a settlement is a framework of the whole social activity and this framework influences the range and forms of this activity. The conditions of our life depend not only on our individual endowments and situations but on our dwelling place as well.

One of the most frequently discussed problems of the recent past development of our settlements is connected with the future of our villages. The most decisive reason of it is that the demographic situation has lately become very favourable, the rate of rural population has gradually decreased, some tiny villages wholly or almost wholly have lost their population.

The relation between the size of a settlement and the decrease of its population is not synonymous as some villages could keep their population owing to some outward or inward reasons.

On the other hand the decrease of population is not absolutely a negative thing,though its increase is a positive one. Generally the culmination of population is connected with the role it plays in the division of work of a settlement and its place in the region.

The aim of this investigation is to discover how the population of a village Földeák changes owing to its dwellers' migration.

The material for analysis was collected with the help questionnaires. The intensive adult population (Over 18 years) was surveyed.

Földeák is a settlement in a special geographical position in the southern part of the Great Hungarian Plain. It is situated in the eastern part of county Csongrád between Makó and Hódmezővásárhely, nearly in the middle of them. It's a transistory territory and so it's tipically drawn from different sides. Concerning its size with its about 3600 inhabitants it belongs to the same category as about the half of the settlements of the country.

Its traffic-geographical conditions are favourable, its infrastructural and social provision is on an average level, on the basis of some indices it's a little bit better, according to other ones it's a little bit worse.

According to the most important demographical indices concerning the numerical formation of population Földeák belongs to the settlements of unfavourable endowments. It reached the maximum of its population before the Second World War, in 1941 it had 5626 inhabitants and since then its population has been decreasing though the rate of decrease is less than the average one. The first cause of it is that the birth rate has permanently been decreasing, and the negative growth is due to it. The rate of birth and death between 1975—1985 was the following:

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Birth	80	62	48	46	46	38	30	37	36	24	33
Death	55	54	63	55	60	62	67	63	53	61	52

The second component of the actual growth the migration difference is also negative. In some years, however, the number of incomers is greater than that of outgoers, but concerning a longer period the difference of incomers and outgoers is not positive. With our survey we wanted to collect some data in the migration to be expected. On the questionery- among other pieces of information concerning the planned migration- the following questions were:

whether one wants to move out of the village
if yes, when?
where?

Concerning their intention 134 persons out of 1704 (7,9%) answered yes. This rate would mean a considerable population decrease if they moved out at once. But as we can see later the answer yes means only an uncertain, distant plan, it's only a desire and not a concrete intention. (For the sake of simplicity we call the total number of people taking part in the survey „all adults" and the ones who want to emigrate „emigrants"but we must not forget that people questioned there do not mean the whole population and the declared desire is not equal to emigrating.

The answers referring to the point of time of a palnned emigration we grouped according to their frequency, or the ones who wanted to emigrate according to their answers: 1, 2, 3, 4, 5, or more than 5 years they want to move out. The inhabitants whose migration was only a desire and they did not give the point of time or they were uncertain were put into the 6. category. The rate of ones who want to emigrate in 1-2 years is the highest (27,6% and 26,1% respectively). The two categories together are 53,7%. These answers can be supposed to express definite intention or even activity (building, application for a flat etc.), that's why they gave such a short term, consequently they can be considered effective emigrants as well. The second highest category is uncertain about the point of time. Most of them are uncertain about choosing the new dwelling place as well, so they are who expressed not a factual moving plan but only a distant desire in their answers. (table 1.)

Table 1.

THE PERCENTAGE DISTRIBUTION OF WANTING TO EMIGRATE
ACCORDING TO THE PLANNED TIME OF EMIGRATION AND ITS PLACE

The place of the planned emigration	The time of the planned emigration (years)						Sum total	All emigration in %
	1	2	3	4	5 or more	uncertain		
Makó	43,5 / 28,6	30,4 / 38,9	8,7 / 13,3	8,7 / 40,0	—	8,7 / 5,4	100,0	17,2
Hmvhely	29,4 / 28,6	14,7 / 27,8	8,8 / 20,0	2,9 / 20,0	20,6 / 29,2	23,5 / 21,6	100,0	25,4
Szeged	24,1 / 20,0	3,4 / 5,6	10,3 / 20,0	3,4 / 20,0	37,9 / 45,8	20,7 / 16,2	100,0	21,6
Bp	57,1 / 11,4	14,3 / 5,6	14,3 / 6,7	— / —	14,3 / 4,2	— / —	100,0	5,2
Surrounding settlement	— / —	— / —	— / —	— / —	— / —	100,0 / 5,4	100,0	1,5
Remote settlement	50,0 / 11,4	12,5 / 5,6	— / —	12,5 / 20,0	125, / 4,2	12,5 / 2,7	100,0	6,0
uncertain	— / —	9,7 / 16,7	19,4 / 40,0	— / —	12,9 / 16,7	58,1 / 48,6	100,0	23,1
Sum total	100,0	100,0	100,0	100,0	100,0	100,0		
All emigration in %	27,6	26,1	13,4	11,2	3,7	17,9		100,0

The answers referring to the new dwelling place — question where — were also grouped: Besides the most frequently named Makó, Hódmezővásárhely, Szeged and Budapest were called „surrounding settlements" all the villages and towns that are not farther than 50 kilometres from Földeák, and all the places, including foreign countries as well were called „distant settlements". Summarising the answers Hódmezővásárhely became the first among the dwellings. It is motivated with the nearness and the dynamic development of the town.
Szeged is the second and Makó is only the third in the row. A great number of people gave an uncertain answer the question „where" and half of them could not decide the point of time either. (see as above) The attraction of the surrounding settlements is the weakest, only 1,5% of migrates chose them in an uncertain time.

If we analyse the answers given to the questions „when" and „where" a more detailed examination shows the direction of migration and its formation in time more precisely and it gives a more favourable picture of Makó. It can be concluded that about 1/3 of all emigrants in 1-2 years wanted to move to Makó and not much of them to Hódmezővásárhely, and only a little more than 1/6 to Szeged. On the other hand 3/4 of those who are moving to Makó plan to move in 1-2 years, and 44% want to move to Hódmezővásárhely, and exactly 28% want to move to Szeged in 1-2 years. It means that Makó is the first among the people who are most determined to emigrate, the second place is Hódmezővásárhely and the third one is Szeged. (table 1.)

Then we analysed the composition of those wanting to migrate in details according to their age and sex. According to their age the ratio of the youngest generation between 18-25 was the highest. (nearly 40% of the total number of emigrations) though this group of surveyed people is the smallest (11,3%).
It is unfavourable from the demographical point of view but it could be expected as this age group is the most mobile (as they haven't had their own home, or haven't decided yet where to settle down). Namely this is the very group that deals with founding a family, building or buying a flat, so their choice is the widest.
The intention to move somewhere is gradually decreases together with the age, the ratio of the age-group of those wanting to migrate is roughly coincide with that of all adults. A new rise can be experienced among pensioners and the elder but the motives here are quite different, their purpose is to establish a more comfortable and secure old age.

The distribution of emigrants according to their sex is also interesting. Totally women's number is greater than that of men but their ratio is changing depending on their age. The rate of women is strikingly high in the youngest category (it is approximately 1/3-2/3 for women). Concerning middle aged emigrants this ratio is roughly equalized, then the ratio turns over and in the age-group of 56-65 years it has an opposite sign that is 2/3 of emigrants are men. When the emigrants are over 66 the number of women is more again. It has to be mentioned, however, that these two latest categories are only a small ratio of the whole number of emigrants. (table 2.)

We have investigated whether the number of children decides planning migrating or not that is whether the number of migraters is more or not among childless families or families with 1, 2, 3, 4, 5 or more children.

Table 2.

THE DISTRIBUTION OF FUTURE EMIGRATORS ACCORDING TO THEIR AGE AND SEX

	The age of emigrants						Sum total	All emigration in %	All adults in %
	18—25	26—35	36—45	46—55	56—65	over 66			
	years								
Men	31,1 36,5	27,9 50,0	13,1 47,1	14,8 56,2	6,6 66,7	6,6 44,4	100,0	45,5	47,5
Women	45,2 63,5	23,3 50,0	12,3 52,9	9,6 43,8	2,7 33,3	6,8 55,6	100,0	54,5	52,5
Sum total	100,0	100,0	100,0	100,0	100,0	100,0			
Sum total in %	38,8	25,4	12,7	11,9	4,5	6,7		100,0	
All adults in %	11,3	20,7	18,0	15,3	16,6	18,1			100,0

Our examination shows that there is no decisive connection between the number of children and migration, it is not a decisive factor in migrating. It's true that the number of childless is greater than that of among the all adults but it is caused by the fact that majority of those who want to migrate are young and that's why they haven't had children yet. Otherwise the rate of the other categories is similar to that of all adults.

According to the question if they have children whether they live together with them or not the ratio of those who live together with them is similar to that of migrators and all adults taking part in the survey. There is certain difference with those who have children and they don't live together.
This ratio is smaller than that of migrates taking part in the survey obviously because this category represents the group of the elder among future migrators and their number is much fewer than that of the young. At the same time it shows that migration after the emigrated children is not decisive.

Division of those who want to migrate according to their education is also particular and instructive. The rate of those who finished secondary school (vocational school, secondary technical school, secondary grammar school) is the highest,more than half of them finished such type of school. Concerning their number eight grade school leavers represent the second category and graduaters the third one. However, if we compare the education of all adults with that of the group of migrators we can see even more strikingly that with rising the level of education the desire to emigrate proportionally increases. 70% of all adults finished eight classes or fewer, 35% of migrates come out of them. 27% of surveyed had finished secondary school and more than the half of migrates came out of them. 3% of adults graduated and 10% of them wanted to emigrate that is their ratio manifolded that of all who took part in the survey. (table 3.)

Table 3.

THE DISTRIBUTION OF ALL ADULTS WANTING TO MIGRATE AND TAKING PART IN THE SURVEY ACCORDING TO THEIR EDUCATION

Schooling	Migrations in %	All adults in %
Less than 8 classes	14,2	34,7
High classes	20,9	35,3
8 and fewer classes together	35,1	70,0
Secondary school	55,2	27,3
Graduated	9,7	2,7

According to their occupation the number of manual worker is decisive: 53% (where the ratio of people working in the agriculture is low, only 1/6 of all manual workers). The ratio of pensioners is coperatively high: 9,0%.

Comparing the place of birth of those who want and don't want to emigrate the following is worth mentioning: the ratio of migrators is the lowest among the people who were born at Földeák and the highest among who were born at Makó and Hódmezővásárhely. In our opinion the cause of it that they were not born in their village but in hospital of a near town because of the developing health service, so the high ratio of young adults raises the ratio of those who were born at Makó and Hódmezővásárhely among those who want to emigrate. The number and ratio of those who were born besides these three settlements in other villages and towns can be neglected.

We have tried to discover whether the connections of relatives influence the desire to emigrate that is whether the villagers having connections of relatives with other settlement more often plan to emigrate or not. First of all we discovered the number of such relations that is we asked them whether they had relatives in other settlements. We found 182 relations of relative among them, we took for one the relation if someone had relatives at one settlement (independently of its number), and we took for a second relation the relatives at the second settlement.

Future emigrators have more such relations (70,9% have relatives at other settlement) than those who don't want to emigrate. (52,2%) Comparing the connections of relative of these two groups according to their settlements we generally found similar ratio. Makó and Hódmezővásárhely are the first but not with an extreme ratio, the role of Szeged and Budapest is only a little less. The ratio of Budapest relatives is a little higher and that of living at remote settlements is a little lower concerning people who want to migrate than in case who don't want.

The connections with the relatives living at Földeák are also weak. The percentage of those who have no relative there and want to migrate is a little bit higher than that of who have and don't want to migrate, but the differences can be neglected.

We tried to define the intensity of the connection of relative with the frequency of visits with the following questions: How often do you visit your relatives? (don't visit them, yearly, once half a year, 2—3 times a month, monthly, twice a weak, or more often)

Though we couldn't divide the number of visits of the relatives living there and at other settlements but we could realize that people dealing with emigration visit their relatives more often than the average, so they live in wider relation, more mobile and often group.

According to the example of Földeák we can summarize that the rural form of life attracts the young, women and people with higher education the least, so first of all they try to choose another dwelling place. The ratio of emigrants among old people has also increased a little. They prefer the two neighbouring towns as a new residence but Szeged and Budapest are also favoured by them. The number of children and the residence of children not living together with them is not a decisive

factor. The influence of connections of relative is weak both in the respect of incentive to emigrate both in the respect to keep the population.

In the end we have studied now great the number of people moving there among those who took part in the survey. 237 of them have moved to the village during the past 15 years (between 1970—1985) (66%) approximately in a uniform distribution, generally 15 persons per year. This modest rate of mowing in can't keep the balance with moving out in the future either and it contributes to the further slow decreasing the population.

In the history of formation of the number of population of Földeák a certain change can only be expected if the nearness of the towns means a decisive advantage for it, that is if the threefold system of connection of Szeged-Hódmezővásárhely-Makó has got strong owing to the co-ordinated development, and it enters its deconcetrated stage of the forming agglomerational development. In this stage the growth of population of town will decelerate and the ratio of village population will begin to grow especially in villages being in a similar geographical position around towns as Földeák.

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О ВЗАИМООТНОШЕНИЯХ ГРАНИЦ МЕДЬЕ И РАЗВИТИЯ ТЕРРИТОРИИ

И. Шимон

Центр региональных исследований, Альфёльдское отделение
Békéscsaba 5000, Венгрия

Несмотря на значительный вложенный труд и на многократные дискуссии, ни исследования по огранизации экономических районов, ни специалисты практики не могли создать гармонию экономического и административного разделения пространства в Венгрии. Управление общественно-экономическим пространством до сих пор осуществляется по той системе медье, которая — хотя с некоторыми меньшими и большими изменениями — имеет свое около тысячелетнее прошлое. Медье и после 1945-го года оставались теми территориальными единицами, которые были в силах защищать территориальные интересы. Такого рода представительство могло осуществляться даже в 1950-х годах, при сильной централизации управления. Коллегии медье определяли распределение средств на развитие по отдельным частям медье, централизовали финансовые средства, произведенные в медье, и параллельно вели борьбу в интересах получения как можно большей части из центрального бюджета. Такого характера роль медье в организации общественно-экономической жизни провело к тому, что они стали территориально-экономическими единицами среднего уровня. Однако, так как самостоятельность приводит с собой и некоторого рода обособление, в результате неодинаковой политики развития населенных пунктов и разной системы оказания предпочтения в отдельных медье, вдоль границ медье создавались пространства невыгодного положения, или, если и существует более сильный центр поблизости от границы, его положительноевлияние не может полностью распространяться на соседнее медье. Не случаю, что и по действующему документу Центрального Планового Бюро значительная часть отсталых пространств протягивается вдоль границ медье. Другие находятся в государственных приграничных зонах, где связи с соседними странами еще не могут оказывать влияния на развитие территории (рис. 1). Изложение последней сложной политической и экономической проблемы не является целью настоящей статьи.

Рассматривая вопрос отсталости, можно сказать, что положение некоторого региона — в общем понимании — зависит от того, в какой мере он может участвовать в государственной системе территориального разделения труда. Однако, подключение к этой системе — особенно в случае планового хозяйства — не без помехов. Предполагая спонтанные процессы, некоторый

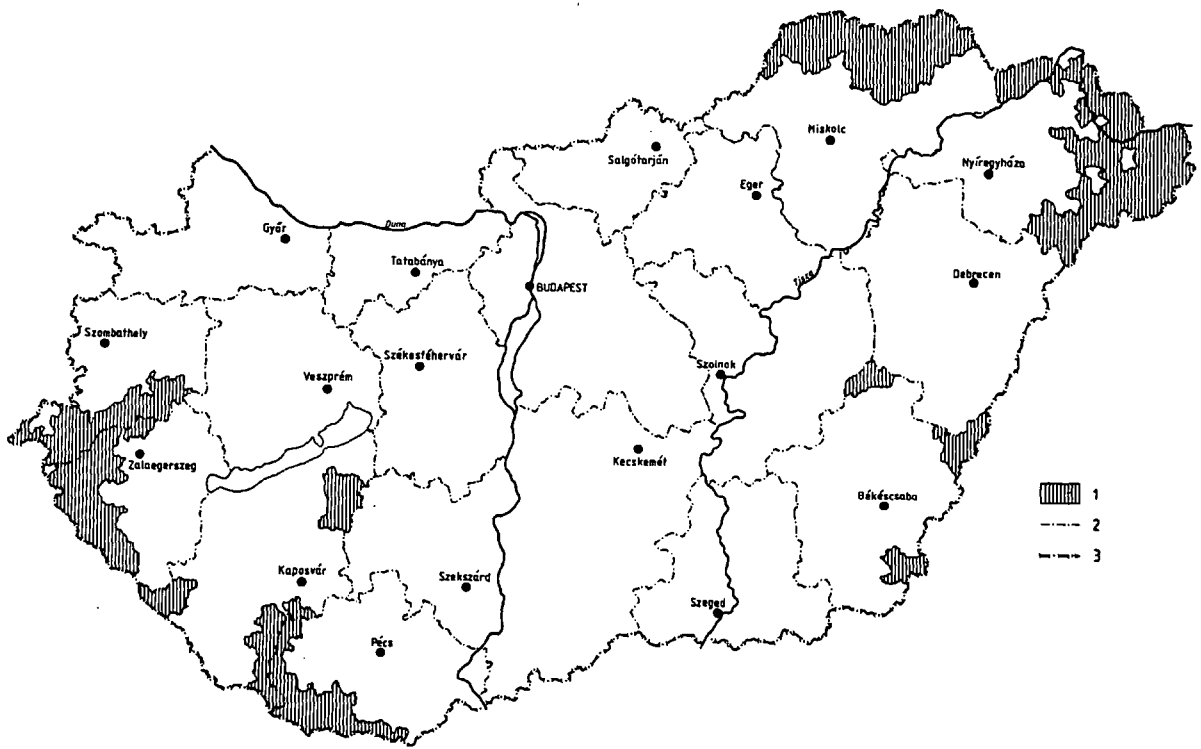

Рис. 1. Отсталые регионы в Венгрии (по Центральному Плановому Бюро)

1: отсталые регионы, 2: границы медье,
3: государственная граница.

регионов станет отсталым тогда, когда общество дает низкую оценку деятельности, которая ведется в данном регионе. Соединяя эти два подхода можно сформулировать, что отсталость представляет собой общественную оценку того, как некоторый регион может подключаться к системе территориального разделения труда. Такое определение предполагает идеальные условия, т.е. не касается таких вопросов, как возможности и формы защиты интересов, механизм планирования и подготовки решений и т.д., которые могут сильно модулировать как степень участия в системе разделения труда так и его оценку.

Задачи перед научным исследованием проблематики

По имеющимся результатам исследований подтвердилось, что в становлением отсталости играет роль расположенность по границе медье. Об этом свидетельствуют и многочисленные конкретные явления, которые влияют на повседневную деятельность человека. Таковым является, например, ограничение возможностей использования учреждений здравоохранения, территориальная рассеянность учреждений, где производятся разные официальные дела, и т.д. Хаотические территориальные взаимосвязи, появляющиеся при общественно-экономичейих деятельностях, распространяются за пределы медье. Это содействовало образованию искаженной возрастной структуры в поселениях вдоль границ, что наблюдается параллельно с убыванием числа их населения. Осознав сложившуюся ситуацию, Академия Наук Венгрии взяла инициативу организовать исследования по таким регионам. В связи с этим уже началась разработка концепции исследований и определились целевые установки.

Целью исследований является не «перекройка» границ медье, — хотя, надо отметить, что и это могло бы иметь научное обоснование —, а раскрытие связей тяготения некоторых центров за пределами их медье, определение системы зон тяготения, описание дорог развития исследуемых пространств (поселений). Коренное исменение границ медье требоволо бы комплексных общественно-экономических исследований на государственном уровне и с гораздо большим аппаратом, и, прежде всего, политического решения. Естественно, не исключено, что в обоснованных случаях сформулируются предложения присоединить какие-нибудь поселения к другим медье. Роль границ медье в значительной мере изменилась бы в случае, если бы отдельные люди и семьи могли более свободно решать о том, где они используют различные услуги в соответствии с их потребностями. В последнем цлучае шкала услуг в поселениях, находящихся в более выгодном положении в отношении территориальных связей, расширалась бы, а также усилились бы соответствующие функции обслуживания. В такой ситуации границы медье регулировали бы только передвижения в связи с официальными делами, частость которых меньше частости поездок по делам, сопутствующим

ежедневой жизни. До такого состояния сегодня еще далеко. Именно поэтому исследования должны дойти до такого уровня, с которого станет возможным определить те механизмы, с помощью которых автоматических смягчится напряжение в ежедневной жизни людей от местожительства по границе.

Важность природной среды в общественно-экономических процессах должна отражаться в исследованиях с двух аспектов. Во-первых, какую роль линейные природные элементы ландшафта играют в ориентировании связей? Во-вторых, в какой мере природные условия содействовали отсталости, или могут оказать влияние на дальнейшее развитие?

Сверх круга вопросов по *пространственным связям,* по реляции «центр—периферя», по особенностям перемещений населения, по *производственным связям* отдельнох отраслей, по экономическим дорогам локального общества, и т.д., в наиболее проблематичных регионах необходимы и *глубокие социологические исследования,* которые должны касаться и структуры общества, структуры семей и процессов формирования общественных отношений. Также должна анализироваться система политических учреждений поселений, их роль в развитии населенных пунктов, далее, вопросы самофинансирования поселений в условиях новой системы нормирования.

Исходя из реально имеющихся возможностей, не все приграничные поселения могут быть взяты в изучение. Должны выбраться некоторые территории. На основе прежних исследований выявилось, что на Альфёльде *четыре конфликтные территории* обязательно должны быть проанализированы. Эти: 1. поселения по южной границе медье Хайду-Бихар и по северной границе медье Бекеш; 2. поселения на стыке границ медье Бекеш и Чонград; 3. район Тисазуг на стыке границ медье Бач-Кишкун, Сольнок, Чонград и Бекеш; 4. окрестность города Тисафюред на стыке границ медье Хайду-Бихар, Хевеш, Боршод-Абауй-Земплен и Сольнок (рис. 2).

Уже на начальной стадии работы ощущается «скользкость» поля исследований. Некоторые руководители медье приходят в ужас от мысли таких исследований, боясь от возможных предложений разбить их медье. В некоторых приграничных поселениях говорят, что «надо не исучать, а помогать; не важно, в котором медье мы оказываемся в неблагоприятном положении, скорее хотим решать более свободно в делах, касающихся нас». Бывают люди, которые приветствовали бы присоединение к соседнему медье, что было только юридическим утверждением и без того имеющейся сильной привязанности к естественному центру. Некоторые бесконечно перечисляют ординарные случаи, когда самое существование границы медье виновато. Говорят, что на границе медье переместили больного в машину скорой помощи соседнего медье; в другом случае отказались с локальной машиной скорой помощи перевезти больного в соседнее медье. В некоторой деревне была построена пожарная часть только потому, что правомочный пожарный центр находился слишком далеко — хотя до пожарников соседнего медье было всего 10 километров. Бывало, что к участковому врачу могли обращаться на месте, но на специальное обследование должны были ехать в соседнее

медье, а на лабораторный анализ — в третье. Перечень можно еще продолжать, дополняя его и положительными примерами о том, как из соседнего медье снабжаются приграничные поселения продовольственными и аптекарскими товарами, школой и т.д.

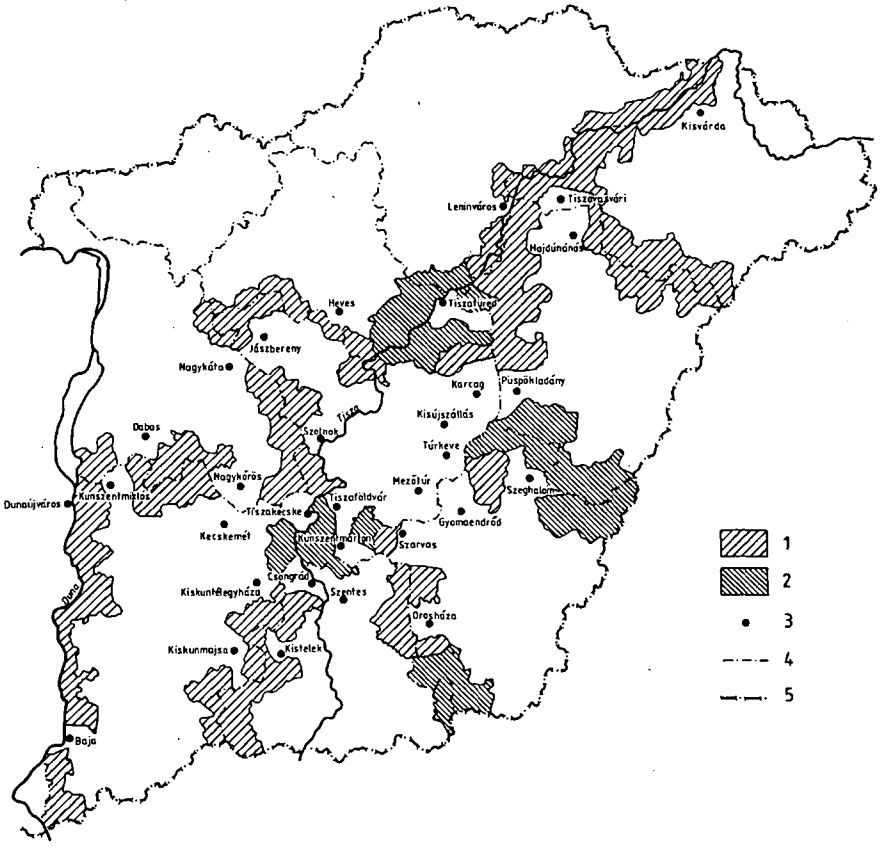

Рис. 2. Регионы Альфёльда по границам медье
1: проблематичные регионы,
2: регионы, взятые в исследование,
3: центры при границах медье,
4: границы медье,
5: государственная граница.

Итоги

— Тема исследований выходит за пределы проблематики определения изменений границ медье. Она содержит в себе и вопросы организации общества, управления, распределения средств, экономики, и даже проблемы использования природных и общественных ресурсов.

— Анализ выбранных типовых территорий даст возможность определить возможные дороги развития на уровне малых регионов, и влияния общественно-экономического управления на эти дороги.

— Станет также возможным определить те практические мероприятия, которые будут содействовать смягчению напряжения в ежедневной жизни людей, исходящего из местожительства по границе. Таким образом, общектив но определится роль соответствующих регионов в территориальном разделение труда.

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JATE Kalmár László Kibernetikai Laboratórium
CODEX Számítógépes Szövegszerkesztő VGMK végezte

88. 810089 Petőfi Nyomda, Kecskemét
Felelős vezető: Birkás Béla vezérigazgató